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## THE MEZQUIT.[1]

BY DR. V. HAVARD, U. S. A.

*Name.*—This tree, the most notable feature of our Southwestern sylva, belongs to the large order of Leguminosæ, suborder Mimoseæ. It was first described by De Candolle under the name of *Prosopis juliflora*, which, therefore, has precedence. Prosopis, as applied by Linnæus, is meaningless; the specific name (julus, a catkin) refers to the catkin-like spikes of the inflorescence. It is the *Algarobia glandulosa* of Torrey and Gray's Flora (from Algaroba, Mexican synonym of mezquit, the specific name referring to the stalked glands borne on the anthers), later changed into *Prosopis glandulosa* by Dr. Torrey, in the Flora of the Mexican Boundary Survey.

*Habitat.*—The mezquit finds a congenial home through Mexico, and extends to Chili and Brazil in South America. It flourishes on the southwestern territory of the United States, specially in Texas, New Mexico, and Arizona, being by far the most common tree or shrub of the immense desert tracts drained by the Rio Grande, Gila, and Lower Colorado. It does not grow near the seashore, except at the mouth of the Rio Grande. If, from this point, we proceed northward, we find that the mezquit disappears from the coast and recedes inland twenty or thirty miles, remaining at about that distance from the sea up to Victoria and Columbus; thence the line of its eastern limit runs directly north, passing a few miles out of Dallas; bending slightly westward, it then

[1] This name, often misspelt and mispronounced, is, in its Mexican form, mezquite, with the accent on the penult, and the last syllable obscurely sounded. North of the Rio Grande, in its Americanized form, it drops the final e, but otherwise retains the Mexican accent and pronunciation, thus, mezkeet'.

crosses the Red river, and, entering the Indian Territory, passes north of Fort Sill, crosses the Canadian, and strikes the 37th parallel where the 100th meridian intersects it. Near this point, Mezquit creek, from Kansas, empties into Cimarron river. The northern limit may be said, practically, to be the 37th parallel; that is, the southern boundary of Colorado and Utah. It takes in the southern point of Nevada, the large desert tracks of South-eastern California, and, at its extremity, bends down towards Fort Tejon. The western limit is the rather uncertain line made by the western margin of the Mojave and Colorado deserts, nowhere, as far as I know, coming close to the shore of the Pacific.

*Description.*—Shrub, or tree, with thorny branches and deciduous foliage.

Bipinnate leaves, single or in clusters, mostly armed with a pair of stout, straight, whitish thorns. One, seldom two, pairs of pinnæ; these 3–6 inches long, bearing 8–15 pairs of leaflets, which are linear-oblong, rigid, 1–2 inches long, and 1½–3 lines wide, varying much in size according to soil and stage of growth. Petiole 2–4 inches long, minutely stipulate, bearing at its apex a cup-shaped gland and filiform appendage.

Flowers 5-parted, a line or more long, on short but distinct pedicels; in axillary, short-peduncled, cylindrical spikes, 1½–4 inches long; greenish-white at first, later more conspicuously yellow from the exserted stamens; very frequent. Calyx smooth, short, hardly half as long as the corolla, with short, acute teeth. Petals valvate, narrowly long, free, greenish or yellowish-white, smooth outside, woolly within and at the apex. Stamens 10, free, exsert, straight and diverging, at least twice as long as the corolla, with versatile anthers; the large, blackish connective mostly bearing at its apex a stalked gland. Ovary shortly stipitate, woolly; style with small terminal stigma as long as the stamens.

Ripe pods white yellowish, mottled with red; 4–8 inches long, 10-20 seeded; from 2 to 12, seldom more than 5 or 6 on the same peduncle; linear, compressed, falcate, constricted between the seeds, indehiscent. Exocarp ligneous and tough; mesocarp thickish and spongy; endocarp papyraceous, inclosing the seeds in separate, flat casings, quadrate from natural pressure, and placed obliquely in the pod of which they occupy nearly the whole breadth.

Seed oval, smooth, suspended from the apex of the apparent

cell by a long, coiled funiculus, with ascending radicle and plane, foliaceous cotyledons.

*Size and Shape.*—In size the mezquit ranges from an inconspicuous bush to a middle-sized tree. On high plains, alkali flats, or stony bluffs, it is a gnarled, stunted shrub, while on rich bottom-land it becomes a tree forty feet high, with an undivided trunk 2 feet in diameter, and from 7 to 10 feet long. Most of the arborescent mezquit, however, is only 6–12 inches thick; and shrubby mezquit, of all proportions, preponderates over the arboreal. The largest trees I have seen are in Southeastern California and Southeastern Texas.

The trunk usually divides a short distance above ground, and gives off crooked branches at various angles and heights, so that most trees have a loose, straggling, unsymmetrical shape. Under very favorable circumstances the mezquit becomes even-spreading and round-headed, bearing at a distance some resemblance to the apple-tree.

*Foliage.*—The mezquit, naked and repulsive in winter, begins, early in March, to clothe itself with verdure, giving life and freshness to the dreary slopes and bottom-lands. Its early foliage is of the most delicate emerald-green, which gradually deepens without ever reaching a somber hue. The scattered leaflets, thin and rigid, sift the sunlight, and only throw on the ground a speckled and illusory shadow, in which one vainly seeks protection from the heat. This thinness of foliage, apparently intended to prevent excessive loss of moisture, would prepare one to expect comparatively few stomata on the surface of the leaves, they being the open mouths through which aqueous exhalation takes place; but the fact is, that they are numerous, indeed far exceeding in number those found on plants growing in more favored climes. Thus the mean of several observations was, for the upper surface, 63,660, and for the under surface 143,235 on the square inch. It may be noted that the leaflets stand in all positions, oftener in a vertical or oblique plane than horizontally, and therefore that the difference between the two sides, almost equally exposed to light, is also remarkable.

*Flower and Fruit.*—The mezquit begins to blossom about the middle of May, and crops of flowers succeed one another until the middle of July. The pods, or "beans," form early in June, and ripen throughout July and August. In dry places they are

ripe before the end of June, while in other localities they are not yet mature on the first of September.

*Roots.*—The roots of the mezquit seem, in a great measure, to exist independently of the stems, and may attain large proportions when hardly any foliage is visible above ground. It is probable that when the branches have been destroyed by fire, or stunted by hot, desiccating winds, the sap brought up by the deep rootlets is mostly assimilated by the upper superficial roots, which grow thick and tortuous. Sometimes, in the Southwest, camps are pitched on plains where no timber or fuel of any sort is visible. It is then that the frontiersman, armed with spade and axe, goes "digging for wood." He notices a low mound, on whose summit lie a few dead mezquit twigs; within it he finds large, creeping roots, which afford an ample supply of excellent fuel. These roots can be pulled out in pieces fifteen to twenty feet long, with a yoke of oxen, as practiced by the natives in the sandy deserts of New Mexico and Arizona, where no other fuel can be had.

Mezquit roots are of two kinds. Some dip vertically into the ground, solely in quest of food; others spread laterally, often many yards, before sinking inwards, their object apparently being to extend the area of supply and steady the plant. These horizontal roots, radiating in all directions, form a loose netting in the subsoil, helping to hold and compact it together. The heaping of the sandy soil around the base of the stems, by the wind, causes secondary roots and branches to start, which entrap and retain more of the light earth, so that presently each tree or shrub appears as if growing from a mound. Of the vertical roots, the taproot is often the only large and conspicuous one. It plunges down to a prodigious depth, varying with that at which moisture is obtainable. On the sides of gulches one can trace these roots down thirty or forty feet. They branch off and decrease in size if water is near by; otherwise they, even at that depth, retain about the same diameter, giving off but few unimportant filaments. How much farther they sink can only be conjectured. In the valley of the Rio Grande, big mezquit trees grow at an altitude of forty and fifty feet above the river level.

It would seem, then, that the mezquit, at least in the arborescent form, does not depend for the water it requires upon the moisture of the subsoil, but is enabled to extract it from the lower strata, and that its spongioles are bathed in permanent water. This is

useful practical knowledge. Thus, wherever it reaches the proportions of a tree, we may be reasonably sure that water is within forty or fifty feet, and, wherever it grows as a thrifty shrub, within fifty or sixty, whatever may be the character of the surface stratum. The most desolate parts of the Staked plains are the Sand-hills—bare heaps of shifting sand. Between these are sometimes found large, vigorous mezquit shrubs, the only arborescent vegetation there. The inference would be that water, although too deep for the ordinary shrubs of the country, is accessible to the mezquit, and should be reached at a depth of about sixty feet, a conclusion practically verified by the digging of wells along the Texas-Pacific railroad.

When the roots have to dip down to a greater depth than sixty feet, the stems remain dwarf and scrubby.

*Climate and Soil*—The mezquit is not very sensitive to cold, and frosts, if not below zero, do it no apparent harm. It thrives best, however, in a hot and dry climate; one with mild winter and high summer temperature, small rainfall and clear atmosphere. Such climate is that of the Southwestern States and Territories. Within these there is hardly any soil, if not habitually damp, in which mezquit cannot grow; no hill is too rocky or broken, no flat too sandy or saline, no dune too shifting, no prairie too often burned, to entirely exclude it. It attains its full development on dry, loamy bottom-lands, where the soil is rich and porous, the water not too deep, and the prevalent winds shut off. On the contrary, it dwindles to its minimum size, a mere cluster of twigs, on high grassy slopes and rolling prairies, often visited by fires and always swept by winds.

When once in possession of the soil, it becomes a sort of arborescent weed, of wonderful vitality, and most difficult of eradication. Thus I know of a military post where the bushy growth of mezquit covering the parade was cut close to the ground twice a year; but these successive mutilations only rendered it more vigorous, so that the labor of cutting and pruning increased every year. Again, I remember a good-sized shrub which had tumbled down, with the overhanging edge to which it clung, to the bottom of a ravine; there it lay prostrate, mangled, head under, partly buried, and roots in the air. In its fall the main or top root had been broken; but two vine-like rootlets, ten feet long, issuing from the side of the ravine, still remained connected with it, and,

judging from the unfaded foliage, furnished enough nutriment to sustain life.

*Propagation and Growth.*—One, viewing the extent and denseness of mezquit woods, and the intricacy of the many creeping, superficial roots, would be likely to suppose that this plant propagates itself by subterranean runners. Such is not the case. Often, indeed, the base of shrubs, or small trees, becoming buried in the loose soil, secondary branches growing off the spreading lower limbs now under ground, may seem to spring from runners, but it is merely so in appearance; mezquit is propagated by seed only.

It seldom happens that the pods, as they drop to the ground, are placed under favorable conditions for germination; they mostly decay on the soil, or are destroyed by insects; so that we may, in the spring, explore extended woods without finding a single yearling sprout. The spontaneous growth of seedlings occurs only in particularly propitious seasons, at irregular intervals of years.

We often see spring seedlings, growing unbidden, in cultivated beds or plots which have been watered and fertilized; likewise around the edges of manure heaps after rains; so that there should be no difficulty, with some care, to raise the plant from the seed at will. The indehiscent pod should be broken into its many one-seeded joints, and these planted at the beginning of the rainy season in well-prepared ground. Next year the young seedling may be a foot or more high, and can be transplanted, wherever wanted, during the summer rains. In four or five years it has become a goodly shrub.

Thereafter the growth of the mezquit is very slow. When about thirty years old, the stem is seven or eight inches in diameter; when about fifty, from eight to 10 inches; when about seventy-five, from ten to twelve inches; and when the diameter exceeds a foot, the tree is one hundred years or more old.

Generally sprouts grow in clusters, because of the germination of several seeds from the same pod. On rich bottom-land the strongest stem, in time, destroys the others, and alone survives into a tree; on higher and dryer land several of the stems develop simultaneously, forming clusters of thick shoots more or less coalescing at base, a mode of growth common on the hills about San Antonio.

The dissemination of the seed, shut up in the closed pod, is always difficult. There are agencies, however, which may transport pods or seeds at indefinite distances. One is water, rushing with great force through many arroyos towards rivers. To it is due, in part, the fact that most valleys and bottoms are timbered with a large proportion of mezquit. Another is the fæces of horses, mules, cows, and native mammals which feed on the pods; they always contain the undigested pips in good condition for germination.

*Uses.*—The foliage of the mezquit is practically useless. If at times goats or mules are seen to browse it, one may be sure there is no other food within reach. I have been told that, on the Lower Rio Grande, cows sometimes eat the young leaves in the early spring, and that their milk, in consequence, becomes bitter and unfit to use.

The trunk is ordinarily too short, and often too crooked and knotty, to make it serviceable as timber. Mezquit posts, much used in fencing, are said to be indestructible, whether under or above ground.

I believe this plant is capable of making excellent hedges. Seedlings, as mentioned before, are easily raised, and if transplanted in prepared ground during the rainy season, they should, in three or four years, develop into vigorous shoots, which, by proper pruning and trimming, will form impenetrable hedges.

The wood is very hard, heavy, fine-grained, and takes a beautiful polish. Longitudinal sections are prettily marked with wavy, sinuous veins; the very eccentric rings, although very close, are distinct; the serried medullary rays are hardly visible to the naked eye. The heart-wood is richly colored, its several zones varying from yellowish-red to purple, and contrasts sharply with the pale yellow of the superficial layers. These qualities render mezquit wood valuable for cabinet-work. Unfortunately it too often happens that the zones of the heart-wood are fissured, decayed, or detached from each other, so that it is difficult to get flawless boards.

In San Antonio and Brownsville, Texas, pavement blocks of mezquit are used on several streets, and said to answer the purpose excellently well.

As fuel, the wood, from both root and stem, is unsurpassed. It is the most commonly used from San Antonio, Texas, to San

Diego, California, and often the only kind obtainable. According to Dr. Loew, the charcoal made from this wood is of the best quality for metallurgical and smelting purposes.

During the summer months, from May to September, there exudes from the bark of the mezquit a gum which concretes in tears of variable size, and of a light amber color. It has the taste of gum arabic, makes excellent mucilage, and dissolves readily in three parts of water, the solution having a slight acid reaction. Chemically, it is distinguished from gum arabic in not being affected by subacetate of lead, which, in a solution of the latter, throws down a thick, white precipitate.

This gum is mostly found in old, decrepit trees, with thick, cracked bark, and accumulates in knot holes and around fractures. More rarely is it seen on young, vigorous, and smooth-barked trees. The yield is increased by practicing incisions on the trunk. In these the gum which slowly forms above, under the cambium layers, demonstrates its derivation from the descending sap. It often happens that the exudation fails to concrete, and runs upon the bark in large, black, tarry streaks and patches.

The quantity of gum naturally produced during the season by a large tree is small, probably not exceeding a third of a pound. It is doubtful whether the yield could be increased to a pound by incisions. Therefore this gum, although of prime quality, can hardly ever become an important article of trade.

The fruit of the mezquit contains nutritive principles which make it a valuable article of food. Most herbivorous animals are fond of it, and thrive on it. In the field it is a welcome though imperfect substitute for grain. Horses and mules soon learn to know the tree or bush, always abundantly fructiferous, and as soon as let loose go in search of the fallen pods lying in the grass under the thorny branches. While green, and until thoroughly ripened, the "beans" are bitter and worthless as food. At full maturity they fall to the ground, when they should be at once collected before wetted by rain and stored in a dry place. Under these conditions they keep well until the next crop. When left on the ground they soon deteriorate and decay. They have a particular enemy in a small coleopterous insect which lays its eggs in the seeds, so that in picking up an old pod we shall usually find each joint bored with a hole leading to the corresponding seed.

If we take the dry pod, thoroughly triturate it in a mortar with water, and afterwards strain, we get an aqueous extract containing all of its nutritive elements. The residue, nearly one-half (forty-seven per cent) of the whole pod, consists of shreds of the epicarp, the broken endocarp, and the seeds; it is indigestible, and always voided with the fæces. The aqueous extract, containing fifty-three per cent of the pod, consists of vegetable albumen, gum and grape-sugar, with traces of fat and salts. Its pleasant sweetness to the taste at once reveals the presence of sugar; but, owing to some interfering principle, the usual reagents fail to show even a trace of it. It is only after extraction with alcohol, evaporation, and solution in water that Fehling's test can be successfully applied. A careful analysis yielded twenty-six per cent of glucose. Dr. Loew (Rothrock, Botany W. of the 100th meridian) found thirty per cent.

Thus it is seen that mezquit "beans" differ widely from corn or oats in composition, and therefore cannot produce the same effects on animals. Only about one-half its weight being assimilable, it is a much more bulky food. It is rich in sugar and nitrogen, but deficient in starch, fat and salts. Before the advent of railroads, when grain was scarce in San Antonio, mezquit pods were regularly brought to market and sold for a dollar a bushel.

They constitute a favorite food of Mexicans and Indians. The ripe pod is ground on the "matate," the seeds picked out, and the coarse flour thus obtained is cooked into cakes, or, after seasoning, wrapped in corn-husks like "tomales." Mezquit "atole" is made by throwing the pods into boiling water; when cooked, they are put in fresh water and pounded into a pulp, which is strained; the liquor, containing in suspension and solution all the nutriment of the fruit, is drank ad libitum, and is a very pleasant beverage. Or, again, the pods may be triturated first and the flour boiled afterwards.

The infusion of this flour can easily be made to undergo alcoholic fermentation, whereby a weak beer is obtained, formerly much used by Comanche and Apache Indians.

# THE LARVAL THEORY OF THE ORIGIN OF CELLULAR TISSUE.

BY PROFESSOR ALPHEUS HYATT.

AT a meeting of the Boston Society of Natural History, held March 5, Professor Hyatt reviewed the history of investigations upon the structure of the Porifera; concluding that though true Metazoa, they nevertheless still retained characteristics of Protozoa. They possess, in adults, the three typical layers, ectoderm, mesoderm and endoderm, and reproduce by means of true nucleated eggs and spermatozoa developed in the mesoderm. The embryos in the lower forms develop, as observed by him and figured by Barrois in Halisarca, by passing through a hollow morula, as do also several species of the higher forms of Carneospongiæ, having silicious spicules, which are now by most authors supposed to have only a solid morula.

The differentiation of the egg is slightest in forms like Halisarca, and possibly also in Gastrophysema, one of the Calcispongiæ; if Haeckel's figures of these really represent sponges. In the higher forms of both Carneospongiæ and Calcispongiæ, especially the latter, the eggs become differentiated into endoderm and ectoderm at a very early stage of segmentation, and all larval stages are much shortened, in accordance with the law of concentration and acceleration in development. This law is founded upon the fact, now generally established by observation, that the young of descendant types inherit characteristics and tendencies, or habits, at earlier stages than those in which they first originated in their ancestors.[1]

Thus the young of Sycandra is the exact structural parallel of the adult of Leucosolenia, a genus of a lower order, Ascones. It is at first a tube with thin walls as in Leucosolenia, and then develops the characteristics of its own order, Sycones, forming a thick wall, and the cœlomatic cavity branches into radiating tubes, keeping up connection with the exterior through open external pores. The cells in the main cavity of the larva, which are all flagellated and collared, lose their cilia and collars except where the enlargements of the branches occur, forming the ampullæ, the essential characteristic gastric cavities of all sponges with thick mesoderm.

[1] See Evolution of Cephalopods, *Science*, Nos. 52–53, and Genera of Fossil Cephalopods, Proc. Bost. Soc. Nat. Hist., Vol. XXII, p. 262.

The three layers can be exactly compared with the three layers of all the Metazoa, the outer, the ectoderm, is essentially a protective and respiratory layer, the inner, the endoderm, is devoted in Ascones to digestion, or rather consists wholly of feeding zoöns, the central, the mesoderm, is a supporting layer secreting the primitive spicular skeleton, as in Hydrozoa, Actinozoa and all Metazoa. This skeleton, in its spicular character, is similar to the primitive condition of the skeleton in most and perhaps throughout all the Metazoa, the mode of formation being essentially at first spiculous and then solidified through the binding together of the loose elements remotely comparable with the spicules of Porifera. It will be noticed also that in sponges the products of the mesoderm are largely inorganic, as in the skeleton in the Metazoa, and the products of the ectoderm are also horny, as in the Metazoa. The skeleton of Keratosa, the well known webs of elastic threads, which compose the masses known as commercial sponges, are not products of the mesoderm, but really built by the ectoderm.

The process of digestion in Ascones and in the ampullæ is purely protozoönal. The cells capture food, living and in an unprepared condition, from the water coming in through the pores. They must be admitted to have retained both the structure and the habits of the flagellate Protozoa, as has been shown by Clark, Carter and Saville Kent. They are really a distinct branch on the lower borders of the Metazoa, derived from the Protozoa, and equal taxonomically to either Hydrozoa or Actinozoa, forming in fact parallels to the first in their development of the cœlomatic cavity and gastrovascular system, and even uniting, in this respect, the two systems of the Echinodermata, the water and gastric system, into one system with two sets of tubes. They have, in fact, the incurrent or supply system formed by the ectoderm connecting with the cloacal outlet system formed by the endoderm in all the fleshy sponges, Sycones and Leucones.

Every sponge may, however, be morphologically considered, when reduced to its simplest elements, as a sac of collared and flagellated cells surrounded by the mesoderm and inclosed in the ectoderm. This sac has but one opening, an excurrent and incurrent aperture, but this opening is not the blastopore or primitive mouth of the gastrula stage. It occurs by a breaking through at the opposite pole of the body after the attachment of the

larva, which occurs mouth downwards, as shown by Schultze in Sycandra. This primitive opening is also present at an earlier stage in the free larvæ of all the higher forms of Carneospongiæ. Haeckel's parallel between the development of the egg and the evolution of forms among Protozoa, from the unnucleated to the nucleated, seems to be correct, and the morula can be equally closely compared with the colonial free forms of Flagellata like Uvella and Volvox. Recent investigations by Balbiani, Bütschli and Engelmann have removed almost every obstacle, which formerly existed, to the close homology of the single cell among Metazoa with a full-grown adult Protozoön. We can now even closely compare the nuclei of the Protozoa and its changes during conjugation and subsequent casting off of part of the nucleus, to the casting off of polar cells in the egg. The heads of the spermatozoön in the Calcispongiæ have been shown, by Poléjaeff, to arise from division of a part of the nucleus, the other or central part either remaining quiescent or, as this author states, form the tails. Almost every author, especially La Vallette St. George, the most thorough student of this subject, consider all spermatozoa as derived from simple processes of cell division. The essential and general character of reproduction among Protozoa is similar, being, as is well known to observers, fissiparous division of the whole body, but this division takes place in the adults at the end of a series of transformations, and is not characteristic of larval stages. The building up of the tissue in Metazoa is due to the quick and rapid division of cells, and if it is granted that Metazoa may be aggregates of Protozoa, they must be considered, in fact, larval forms descended from Protozoa and inheriting the tendency to reproduction, by fissiparous division, at an early stage. In other words, they reproduce while still larvæ and before passing through any transformations, except the very primitive ones which precede and include the nucleated stage.

We can account for the three layers, by supposing that there must have been among the protozoönal ancestors of the Metazoa transitional forms which were colonial, and in which a part of the feeding zoöns, the collared and flagellated cells, became differentiated into flattened protective zoöns. The next stage would be represented by another form, in which to these two classes of zoöns, a third would be added in the shape of supporting zoöns. We can readily imagine all of these as attached colonies, and

even think of the supporting zoöns, which represent the inclosed mesoderm of Metazoa, as resting on the ground. The inclosure might have been simply due to concentration in the larvæ of descendant forms, which connected them with the Metazoa, since this would be a natural sequence of inheritance with concentration of the secondary formation of the mesoderm. Of course this picture can only indicate what seems to us the probable course of the morphology, and also our disposition to regard as unfounded all hypotheses which have asserted that essential structural characters originate, as a rule, in larval stages, or are likely to occur without being derived through inherited concentration of characteristics from former generations. Simultaneously with the differentiation of supporting or mesodermic zoöns, we should also expect to find male and female zoöns arising, if the results of investigations among sponges mean anything, from among the supporting zoöns, or becoming, at least in the immediate transitional forms, confined to this layer.[1]

It is not of course necessary to this hypothesis that no other transitional forms occurred leading to other types of Metazoa, or that all reproductive zoöns originated in the mesoderm. As larval forms, the spermatocysts would inherit the tendencies to spontaneous fission of the nucleus at earlier stages in the successive forms, and the resulting cells or fertilizing elements would acquire the capacities and the habits of the full-grown ancestors, if they also are larval forms. The parallel between the encystment of the spermatocyst in the sponge tissue, and of the adult among Protozoa is closely similar. The process of spontaneous fission takes place in both bodies in similar way after their encystment.

[1] Since the above was written we have received Biologisches Centralblatt for March 1st, 1884, in which Bütschli, the noted student of Protozoa, announces that a colony of Volvox has male and female zoöns as individuals, and that the male produces by division secondary forms which, like spermatozoa, seek out and fertilize the female. Thus Bütschli has discovered the intermediate forms with males and females required by the hypothesis above, and adds exactitude to our theoretical comparisons of the spermatozoa, since in Volvox we have a directly transitional male form, and also, we may add, in Vorticella. We cannot, however, at all join Bütschli in regarding the spermatocyst and the ovum as the morphological representatives respectively of the exclusive male colonies and female colonies of some Protozoa like the Endrina. This would be assuming every cell to be primarily unisexual, either male or female, our standpoint being with Minot and Balfour, that they are primarily sexless or bisexual, that is hermaphrodites, and the sexes the result of independent differentiation.

The products in both cases are the tailed locomotive forms, which are, according to all observers, probably true single cells, which, from the earliest period of their discovery, have been compared or identified with the locomotive monads, the products of the encysted stage in many of the Protozoa.

The essential difference between a spermatocyst and its homologue among Protozoöa consists in the fact that the latter has to become a full-grown feeding zoön before it is ripe, and proceeds to produce by division secondary males, which seek out the female for the purposes of impregnation, while the latter, as its descendant, has acquired by concentration of development, the same powers and habits in its earliest stage, and its sole function is to become encysted and produce larval male cells for the impregnation of the female zoön or ovum. The impregnation in both cases immediately precedes the reorganization of the nucleus of the female (ex. Vorticella), and are followed by a period of reproduction by division, which is infinitely more concentrated in the encysted ovum, as an encysted larval form, than in the free adult Protozoön. The former is thus a builder of close-set tissues composed of larval cells, and the latter of loosely associated colonies of adult feeding zoöns.

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## THE NATURALIST BRAZILIAN EXPEDITION.

### Paper III.—São João do Monte Negro.

BY HERBERT H. SMITH.

*(Continued from page 1014, October number, 1883.)*

ABOUT the middle of February we changed our residence to the village of São João do Monte Negro, which lies on the Rio Cahy, a northern branch of the Guahyba. Small steamboats run up this river from Porto Alegre nearly every day, touching at the various German colonies along the banks, and bringing down mandioca-meal, corn, beans, tobacco and other products.

The Cahy is very crooked, and the lower portion is bordered by a wide flood-plain. The clay banks are steeply cut, and often thirty feet high, so as to be beyond reach of all except the strongest floods. They are covered in many places with heavy forest, leguminous trees and myrtles being abundant; the branches are draped with vines, and palms of one or two kinds are often

seen, so that the scenery reminded us much of river-shores in equatorial Brazil.

Twenty-five miles in a direct north-west line from Porto Alegre, but fifty as the river runs, the flood-plain is greatly narrowed, and picturesque hills appear on either side; these are outlyers and denuded portions of the table-land farther north; near São João none of them exceed 800 feet in height. The village itself lies on a higher portion of the flood-plain, at the foot of one of the hills; only a few of the houses and the Catholic church are on a spur of the highlands. The Cahy being subject to heavy floods, the streets are often overflowed, and once or twice a year the houses are invaded; for this reason many of them have an upper story to which the inmates can retire when the ground floor is covered with water. Notwithstanding these frequent inundations the place is notably healthy, malarial fevers being quite unknown; colds and lung diseases are occasionally prevalent, but only during the cold weather. Nearly all the people of São João are Germans, and the German language is much more frequently used than the Portuguese; there is a German Lutheran church, and a German school where many of the children appear in the characteristic peasant costumes of the Fatherland. But for the whitewashed and tile-roofed houses scattered irregularly along the unpaved streets, and the semi-tropical scenery around the place, one might fancy that São João was a country village in Germany.

We resided at first with some German friends, but after a few days we hired a house, arranging to have our meals brought in from a neighboring hotel. Here we lived quietly for several months, making very extensive collections of the animals and plants of the surrounding country. The colonists soon learned that we paid good prices for any animal which they brought us, and even for snakes and insects, and some of them came nearly every day with specimens to sell; in this way we secured many rare species. After awhile we hired two young Germans as hunters and general servants, and these afterwards accompanied us in our travels. Our house resembled a laboratory; we had improvised rough board tables and shelves for our work, and they were generally crowded with jars of snakes and fishes, boxes of insects, botanical presses and so on. An outhouse which had been built for a kitchen was used for rougher operations, such as skin-

ning large animals and boiling and cleaning bones. Our daily life was varied only with new excursions, or with those pleasant excitements which attend the discovery of some rare species or interesting fact. Yet it would be hard to imagine a more agreeable existence than that which we led; our house was a real home to us, and our warm-hearted German neighbors became fast friends; in the end we were very sorry to leave them.

The country around São João is properly a forest region, but this varies much in its characters. On the hillsides it is very heavy, averaging eighty feet in height; the trees and plants, in the main, are of the same species as those found at Rio de Janeiro and in the Brazilian coast range. I noticed only two kinds of palms (a Cocos ? and a large, spiny Bactris, the latter growing only in swampy places); woody climbers are numerous, and there is much underbrush. Ravines and water-courses are so matted over with bushes and vines that one may often walk on top of the vegetation, several feet above the ground.

The river shores and higher portions of the flood-plain have a vegetation which resembles that of the hillsides, but many of the trees are of different species, and they are generally more spreading in their growth, the branches being covered with parasites and trailing lichens; there is comparatively little undergrowth, and one may walk readily almost anywhere without cutting a path. Probably this paucity of smaller plants is owing to the periodical floods, which are unfavorable to them. Most of the herbs which cover the ground in such places are annuals.

A third kind of forest is the *fachinal*, or "faggot-woods," found on dry, sandy soil, generally rather low land, but above the limits of the highest floods. It is composed of low, gnarled trees, either a continuous wood or forming clumps in open ground. They are tangled but not dense, and the ground beneath is covered with grass and dry ferns. Nearly all the plants of the *Matto fachinal* are distinct from those of the hillsides and alluvial plains, and where the fachinal adjoins other forest the limits are always well marked. In their general features these low woods reminded me of those seen in the interior of Brazil, back of the coast range; probably they may be considered as outlying portions of the latter.

Lower parts of the alluvial plain are occupied by meadows, which are often swampy or half flooded; they form excellent

pastures, though the horses and cattle are often obliged to pass many days with their feet in the water. The flowering herbs of these meadows were very interesting; but botanizing on them and in the fachinal forest was rendered difficult by spiny bromelias, which covered the ground in many places. Ditches lined with these plants were generally used by the colonists in lieu of fences.

To the north of São João the fachinal and meadows disappear almost entirely, and the whole country is covered with lofty forest. This is continuous with that which clothes the whole coast range, but on the northern table-land it is broken by large tracts of grass-land.

Passing south-west from São João, about three miles, the forest all at once disappears, giving place to rolling prairie like that which we saw at São Jeronymo. The change is very sudden and striking, and coming as it does unexpectedly, the effect is almost magical. Riding out of the silent woods, a new world leaps into view; a world of great open landscapes, of rippling light, of glorious sweeping winds; a world where every animal and every plant is different from those of the forest which we left behind. So far as the fauna and flora go, this is, in fact, the end of Brazil. From this point the prairies extend, with hardly a break, away to the Rio de la Plata, and beyond it almost to Cape Horn. Only in a few favored places the forest reappears in small patches, Brazilian islands in the pampean ocean.

The geology of the São João district is rather uninteresting. The hills to the north and west of the village are composed of soft, friable, reddish-brown sandstone, which by intrusions of basaltic and other igneous rocks has been thrown into irregular flexures. The lower portions are soft and often shaly, and as they are more readily washed away the harder upper layers are left in picturesque cliffs. These sandstones and sandy shales show a section of at least 800 feet, and probably they are much thicker. On the Serra de São João, near the village and elsewhere, the harder upper layers are quarried, the stone being used in Porto Alegre for sidewalks and for facings; it is, however, too soft to be of much value.

In this hill the strata dip north-east at an angle of about 15°; elsewhere they present almost every possible strike and inclination. From information which I have, it would appear that the

same sandstone extends northward almost to the limits of Santa Catharina. From the position of the beds there can be little doubt that they lie above the coal rocks of São Jeronymo, but beyond this I know nothing of their age. Careful search was made for fossils but without success.

The Monte Negro is a singular cliff-crowned hill about 800 feet high, lying near the river-shore about two miles south of the village; it derives its name from the somber color of its forest-covered sides when seen against the open campos. This hill is composed of a singular dark porphyritic rock, originally an eruptive mass which cut through the sandstone; by the denudation of the latter it has been left standing like a tower, the upper part rising perpendicularly, while the base, covered with talus, slopes away steeply to the plain. Other hills in the vicinity are formed of the same rock, or of basalt; where these occur in low, damp places the decomposition has sometimes given rise to agates like those of São Jeronymo.

The flora of the country around São João is exceedingly rich. My wife, to whom the botanical collections were relegated, devoted herself especially to ferns, gathering no less than 135 distinct species.[1] Among these were four or five tree-ferns, and many very large brakes. The fachinal forest contained a peculiar set of dry, stiff-looking species; others grew on the branches and trunks of trees and in shady ravines. But by far the richest collecting places were the sandstone cliffs. Where streams fell over these they often presented magnificent pictures, great tree-ferns mingling with giant brakes, and lesser species carpeting the rocks or hanging in fairy curtains from some projecting ledge. Many of the species take root at the ends, and we found one true "walking-fern," which was regularly propagated in this way.

The settlers speak of over fifty kinds of excellent timber in the forest, and there are probably three times as many less valuable species. I made a collection of about seventy-five kinds, many of which were equal in beauty to the finest cabinet woods used in the United States. With the present increasing taste for all ornamental work, it is hardly possible that these fine Brazilian woods should be long neglected.

Our collections, both of vertebrates and invertebrates, were

[1] Two hundred and fifty species have been collected at Rio de Janeiro, probably more than at any other one point in the world.

very large, but I will speak here only of the Mammalia. Of monkeys I heard of only four kinds, three of which we secured. The largest and commonest is a howler, called here *bugiu*;[1] it varies in color from a very dark reddish-brown to a bright red or almost ochre; the light-colored specimens are always the older ones. The largest individual which we obtained was an old male which measured just two feet from the nostril to the root of the tail, the tail itself being twenty-five inches long; the girth was fifteen and a-quarter inches. The bugius wander in considerable bands, nearly always among the branches, but occasionally on the ground; they eat the fruits of forest trees, and perhaps birds' eggs and insects. The females commonly have two young at a birth, and these, when traveling, cling to the long hair at the back of the mother's neck; when sucking they are generally seated on a branch before her. This species wanders only in the daytime, sleeping on boughs at night.[2] The peculiar bony enlargement of the larynx, by which the hoarse cry or howl is produced, is fully developed only in the males, the females being nearly dumb. When traveling the males of this Rio Grande species are also silent; the emission of the cry is accompanied by a kind of dance in which the whole tribe takes part. This occurs sometimes during the day, sometimes at twilight, but in any case the figure of the dance is the same. The males leap rapidly, from branch to branch, in a circular direction, generally by following the outer boughs of some large tree; the females form a larger circle around the males. While moving the males give forth their peculiar cry, and the whole troop appear to be much excited; the performance may last half an hour.

The howlers, it is said, can never be thoroughly tamed; in captivity they are morose and treacherous, often biting severely. There is a black *Ateles* found in the same forest, but much less commonly than the bugiu; of its habits in a wild state I know nothing, but tame individuals are sometimes seen, and these are very gentle and intelligent. Young ones have a curious resemblance to human babies, amusing themselves with bits of straw or sticks, and moving their long arms helplessly; when scolded or struck they give vent to doleful cries, but never attempt to

[1] *Guariba* on the Amazons.

[2] One of the Amazonian species certainly wanders during the night. More than once, when camping near Santarem, I have been awakened by the howlers which passed overhead with their usual hoarse cry.

scratch or bite. They are very fond of caresses, and will lie quite still to receive them, crooning a little in a ridiculously satisfied way. I knew a tame Ateles of another species which always met one with an embrace around the neck; this was not an acquired trick, but simply the natural expression of its affection for human beings.

One individual of a large *Cebus* was brought in; it was a great rarity, and none of our hunters recognized it at all. There is a smaller monkey occasionally seen here, which I judge to be also a Cebus, but we did not obtain specimens. The marmosets do not seem to be represented, at least in the eastern part of this province.

Bats were rather common, but by no means as numerous as in equatorial Brazil, and none of the species which we obtained were very large. So far as I could discover, the blood-sucking kinds are unknown here.

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## THE EXHALATION OF OZONE BY FLOWERING PLANTS.

BY J. M. ANDERS, M.D., PH.D.

*(Continued from page 344.)*

IT became evident that in order that this important question might be set at rest, the conditions would have to be varied and further observations instituted. I now set to work to devise the necessary apparatus to carry on such experiments. Accordingly I had made a glass case large enough to contain a dozen or more thrifty growing plants in pots. Its dimensions were as follows: length, three and a half feet; width, two and a half feet, and height, two and a half feet. A portion of the top was left removable, so as to furnish an aperture through which the plants could be placed in the case and again taken out. Such an arrangement as this would admit the sunlight to the plants and confine their exhalations, and thus give the ozone, if any should be generated, a better opportunity of acting upon the test papers. In all of the remaining experiments here recorded I was greatly assisted by Mr. G. B. M. Miller, my medical student. The apparatus was first placed in the bay window of an occupied sitting-room facing east. The plants here received the sun's rays for at least six hours of the day. A dozen thrifty plants were placed in the

case, which was then accurately closed by the removable piece of glass already spoken of; the test papers having been moistened and tacked on the branches or stems of the plants. In the first series of experiments flowering plants were used, twelve in number, each having several flowers and about four square feet of leaf surface. They consisted of varieties of geraniums, fuchias, begonias, hydrangeas and petunias. Upon these plants eighteen observations were made of about four hours each, during the latter part of the month of May, 1883; weather mostly fair. The Schoenbein showed "very slight" indications for seven of the experiments and one "slight" coloration, there being ten negative results. The guaiacum papers gave more striking results, the change in the papers being marked for ten of the experiments and slight for the remaining trials, save one which was negative. Great care was taken to keep the plants experimented with in a healthy condition; they were also left in the pots in which they had been grown. There are two reasons which can be assigned why the results in these experiments were not very striking with the iodized starch test First, the experiments were of too short duration; and secondly they were conducted indoors, for the air of the case was originally the air of the room, and a portion at least of the ozone which might have been generated by the plants would have been decomposed by the impurities of the air in the case.

With a full knowledge of the very unfavorable conditions under which these experiments were conducted, but encouraged by their moderate success, it was resolved to make a trial of odoriferous flowering plants under the same conditions. Again our little floral chamber was filled with plants, consisting of seven rose bushes, four carnation pinks, and six heliotropes. The duration of observations about ten diurnal hours each; weather mostly clear, two days cloudy. With the Schoenbein test there were "very slight" reactions in most instances, two "slight" and one well "marked," while the guaiacum papers were "marked" in most cases, a couple being "slight." The number of experiments were eight. These investigations suggested the idea naturally that odorous flowering plants might be better ozone generators than inodorous ones. The external atmospheric conditions were very similar during the time of both the preceding sets of experiments, the maximum temperature ranging

from 85 to 88° Fahr. Repeated testing of the atmosphere of the room in which the case was situated gave no indications of the presence of ozone.

The question now very naturally arose whether the colorations were due to ozone or to some of the substances which give the same reactions with these papers; hence, further investigation was necessary in order to exclude, if possible, these interfering conditions, before it could be claimed for plants that they were capable of emitting or converting the oxygen of the air into ozone. It was also deemed important to conduct future experiments out of doors as, for reasons already given, it was expected more decided results would be obtained. The case was removed to the back yard, which lies to the eastward of the dwelling. Here the plants received the sunlight for at least eight hours daily during clear weather, and the yard was of good size. In the first series of experiments in this locality the plants last named were employed.

After observations for seven consecutive days of clear weather the Schoenbein paper gave "slight" reactions in four cases and "marked" reactions in three. The guaiacum paper gave "slight" indications in three and "marked" in four experiments. It will be seen that these experiments gave more marked results than those made within doors. It may be stated that it was found that the coloration of the Schoenbein or iodized starch test was "slight" instead of "very slight" as indoors, and in three cases actually "marked," against one "marked" result in the preceding series. The guaiacum tests were nearly correspondingly more marked. It is probable that the more surprising results of the last series are not attributable solely to the change of location, but also in some degree to the fact that the experiments were of longer duration. A piece of red litmus suspended in the case during these experiments gave no indication of the presence of ammonia. Peroxides of hydrogen could not have been the reactionary agent, since that substance is decomposed at a temperature of 70° Fahr., while the temperature of the atmosphere within the case, which was carefully noted, was never found below 90° Fahr. These observations were made during the first week in June, 1883, the weather being very warm and the temperature of the air within the case being higher than that of the external air. Good reactions were, however, obtained in later experiments,

when the temperature did not mark over 70° Fahr. That the reactions were not due to the nitrous oxides, perhaps the only remaining substances capable of producing like colorations of these test papers, will appear evident hereafter.

It was next proposed to give foliage plants having soft thin leaves a trial. Seven asperdisteus, one fern and three dracænas were chosen for experimentation. These observations were conducted during the first week in September, 1883, for seven consecutive days. The weather was extremely warm, the temperature of the air within the case ranging from 85 to 100° Fahr., the sky was clear during four days and partly cloudy the remaining three. The Schoenbein test paper gave negative results throughout, while the guaiacum gave one "very slight" reaction, the rest being negative also. Thus it would appear that foliage plants have not this power of generating ozone, the function must therefore reside with the flower, but of its nature we shall speak hereafter.

As our first experiments with inodorous flowering plants did not yield results striking enough to afford a basis for positive conclusions, it was considered desirable to apply the tests to them in the open air, which was done. Seventeen thrifty geraniums were employed. The temperature was lower during these experiments than during those made indoors with inodorous plants. For six consecutive days, experiments being of ten hours each duration, the Schoenbein gave one negative, two "slight" and three "marked" blue shades. The negative result occurred upon a rainy day, during which there was no sunshine whatever. This would indicate that sunlight, or at least good diffused light, is essential to the generation of ozone by plants, for the plants were protected from the rain by the glass. There are other physiological processes carried on by plants which are almost entirely dependent upon the power of the sun's rays, *e. g.*, assimilation and transpiration. To the above may doubtless be added the development of ozone.

Observations were continued upon these plants during the second week of September, the result being about similar to those last noted, the Schoenbein gave two "marked," one negative, on a rainy day, and the rest "slight" reactions. The guaiacum papers gave two "striking" and the rest "slight" colorations. As already intimated nitrous oxides, which are present in the air,

change the color of these test papers very much as ozone does. To exclude the possibility of the change in color being due to the nitrous oxides, we tested the air during the latter set of experiments on the outside of the case simultaneously, and found that the papers in this situation gave only one "slight" reaction, and even though this occasional reaction on the exterior had been due to the presence of the nitrous oxides, they could not have caused the much more striking and constant tests obtained on the inside. Again, it is not at all likely that the plants generated nitrous oxides, which in turn might have changed the test papers, for there is nothing in all vegetable physiology to support such an hypothesis. Moreover, it is all the more improbable that nitrous oxides caused the blue colorations, since they did not do so *when foliage plants were employed.*

We do not wish to say dogmatically that all the changes in the test papers were due to ozone, but from the many beautiful reactions obtained, and the systematic precautions taken to preclude the action of other substances known to answer to like tests, it will not be denied that the chief agent in changing the papers was ozone. I was unable to detect the odor of ozone upon which Professor Leeds lays so much stress, but Mr. Miller thought he could detect its presence. It must be borne in mind that the amount of plant life within the case was probably too small to generate sufficient ozone to make it perceptible to the sense of smell.

It would appear certain from these experiments, that the leaves which are so actively engaged in carrying on the important functions, as, for example, transpiration, have nothing whatever to do with the production of ozone. But, on the other hand, it is to the flower that is delegated this highly important, though perhaps hitherto unthought of, function in plant life.

Can we, from the facts derived from these observations, come to any definite conclusions respecting the nature of this function? Is the cause to be sought in the functions of the petals or in the formation of the seed? Let us here recall how ozone can be produced artificially, and it will be remembered that one mode is by suspending phosphorus in moist air. Now it is known that the ashes of seeds contains large quantities of the phosphates. It follows that during the formation of the seeds there is a rapid metastasis of phosphorites in the form of phosphoric acid and

the phosphates to that organ of the plant, and it may reasonably be supposed that in the chemico-vital changes going on in the ovules, phosphorus is liberated and acted upon by the moisture which the leaves and petals are so actively transpiring.

As corroborating this view we may allude to the phenomena of phosphorescence in plants as observed by M. Crié and others. In a communication to the French Academy, M. Crié states: "It is well known that the flowers of phanerogams are capable, under certain circumstances, of producing phosphorescent light. The phenomenon has been verified, especially of the nasturtiums and the marigold. Some years ago I myself saw phosphorescent light emitted in stormy weather from the flowers of the *Tropeolum majus* cultivated in a garden." Although an absolute decision may not be possible, the above facts, when taken together, are suggestive of the correctness of this explanation. The subject, however, merits further investigation.

In the light of the present experiments there can scarce be a doubt but that a manifest relation does exist between vegetation and the ozonic condition of the atmosphere. And this, it will be conceded, is not the least hygienic influence possessed by plants. During fair weather all flowering vegetation in nature is contributing ozone to the atmosphere. In this connection it should be borne in mind that vegetation is largely blooming, that numerous field plants, the forest trees, as well as all fruit trees put forth flowers, and that during this period they all add their quota of ozone to the surrounding medium. Again, not all blooming plants or trees produce their flowers at the same time of the season, so that it happens that there are a certain proportion of different species flowering in turn from early spring till late in autumn, and hence the effect upon the atmosphere with reference to the amount of ozone they give to it must be pretty constant during the whole vegetative period wherever vegetation abounds. We here have another evidence of the fact that in His eternal wisdom the Author of nature has intrusted to plant life the task of maintaining the harmonious composition of the atmosphere. A certain proportion of ozone in the atmosphere is essential to prevent it from becoming too much polluted for animal respiration by the products of decomposition, particularly of azotized substances, which are known to be a fruitful cause of disease, and which are believed by some to serve as carriers for the germs of epidemic and contagious diseases.

Upon this point Professor Kedzie observes: "I call ozone the most energetic of the constituents of the atmosphere. Its presence or absence must have a *controlling influence over the vital powers.* And when we consider that this material is present in such variable amount in a medium which enfolds us every moment of our lives, and where action 'pauses not for matin or for vesper, at noon of day or noon of night,' it seems to me that no one can deny that its influence on human health must be most significant."

Professor Max von Pettenkofer says of the hygienic value of ozone in the air: "It is the constant purifier of the atmosphere from all organic matter which passes into it and might accumulate. The air would have been long ago filled with the vapors of decomposition if it were not for ozone, which oxydizes all that is oxydizable, if only time be allowed for it and too much is not expected at once."[1]

How long it would be possible for animal life to exist were all the atmospheric ozone to be suddenly annihilated, cannot be computed; but that existence would sooner or later become impossible on account of noxious substances which would accumulate in the air, and which it is the office of the ozone to destroy, cannot be reasonably doubted. How infinitely wise and beneficent, then, is the Author of nature in placing beside these destroying elements the means of reparation. And as flowering plants serve as natural ozone generators, they must be looked upon as worthy of being placed in the front rank as hygienic agents.

Perhaps the most interesting phase of this question is the application of the results of our observations to the beneficial effects of the cultivation of plants in dwellings. As already incidentally mentioned, ozone is not detectable in living rooms for the reason that it is decomposed in oxydizing the organic matter present. It was also seen that flowering plants generate ozone indoors during clear weather, and if a dozen thrifty plants, in a case of the dimensions of the one employed, give us a reaction, then it will not be doubted that a living room well stocked with flowering plants would give off sufficient to be of hygienic value, since it is well known that we rarely or never find but a small quantity in the external air, which yet serves to maintain it in a salubrious condition. The air of dwellings is very generally charged with

[1] *Popular Science Monthly*, Feb., 1878.

deleterious substances due to human respiration, insufficient ventilation, the presence of sewer gases, and many other causes. That the hygienic conditions of the air of living rooms is almost universally abominable is admitted by the best authorities, and it is also true that this bad air of our dwellings serves admirably as a culture fluid for the various disease-producing germs. How to obviate the ill effects arising from this unfortunate condition of things is a question of paramount importance. Since plants are capable of generating ozone, which has the power of destroying not only the organic impurities but even disease germs, it follows that the requisite amount of flowering plants grown in our living rooms would, in a great measure, rid the air of these deleterious substances. From these observations it will readily be conceded that the value of house-plants as hygienic agents can scarcely be overrated. That no possible objection can be urged against the practice of keeping blooming plants in our living rooms (excepting in the case of those having pronounced odors, as the tuberose, etc.) has been shown conclusively elsewhere, and the old time prejudice, we are happy to be able to state, is rapidly dying out.

Shall we discard the foliage varieties because they are incapable of producing ozone? By no means; there are also important advantages to be derived from their presence. Not to speak of their æsthetic influence, there is, as already pointed out, confided to the leaf the important function of transpiration or exhalation of watery vapor. This process is carried on so actively by leafy plants as to give them the power to raise the degree of humidity of a closed apartment which is usually far below the health standard, as the writer has shown in previous articles.[1] It simply remains to be said that, in view of these experiments, the flowering treasures of the green-house as well as foliage plants should be welcomed into every household as being among our noblest sanitary agents.

[1] "Transpiration of Plants," AMER. NAT. for March, 1879; also "Beneficent Influence of House Plants," AMER. NAT. for Dec., 1879; also "Hygienic and Therapeutic Relations of House Plants," *Phila. Med. Times* for May 8, 1880.

# THE CREODONTA.

BY E. D. COPE.

*(Continued from the April number, page 353.)*

THE genus Ictops is found from the Bridger epoch up into the Oligocene or White River Miocene. It thus has much the range of the genus Hyænodon. There are three species, of which I give a cut (Fig. 21) of the *I. bicuspis* Cope, from the Wind River beds of

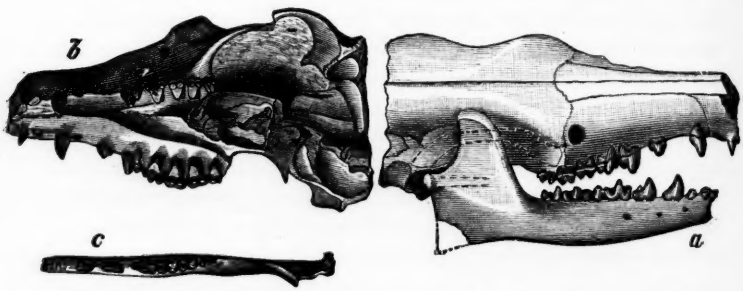



FIG. 21.—*Ictops bicuspis* Cope, skull, natural size. Fig. *a*, oblique view of right side; *b*, do. of inferior side, injured posteriorly; *c*, mandibular ramus from above. From the Wind River Eocene, Wyoming. Original, from Report of U. S. Geol. Survey Terrs., Vol. III.

Wyoming. In this form, as in Leptictis, the incisors and canines are spaced. The White River species is the *Ictops dakotensis* Leidy. But one species of Mesodectes is known, the *M. caniculus* Cope, from the White River beds of Northeastern Colorado. I discovered a good deal of its skeleton, which furnishes an idea of its general characters. Its skull, like that of the *Leptictis haydeni* Leidy, possesses the marsupial character of a subsquamosal foramen (Fig. 22 *ss*), but the resemblance to this order includes besides only the dentition. There is a large keeled præsternum, stouter and shorter than that of a mole, suggesting a burrowing habit, but the humeri are not robust. The neck is very short, and the cervical vertebræ are without neural spines. The cerebral hemispheres of the brain leave the olfactory lobes and the cerebellum entirely exposed, and are wide and short. They are smooth, but the sylvian fissure is visible. This animal was about the size of the European hedgehog (*Erinaceus europæus*).

As yet but one species of Leptictis is known, the *L. haydeni*

Leidy (Fig. 22). This animal has been found in the White River beds of Nebraska. It is about the size of the *Mesodectes caniculus*. It resembles the gray fox of North America in the rib-like temporal ridges of its skull.

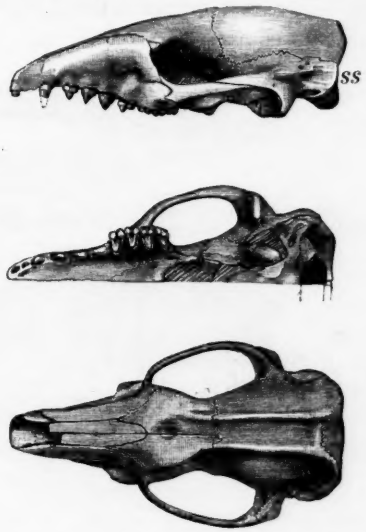



FIG. 22.—*Leptictis haydeni* Leidy, skull, natural size, from the White River beds of Nebraska. From Leidy, Extinct Mammalia of Dakota and Nebraska. *ss*, subsquamosal foramen.

The remarkable genus which I have called Esthonyx, is exceptional in the family in the large development of its second inferior incisors at the expense of the others. One or more of the superior incisors has been supplanted by the large development of the one that remains. The canines are moderately reduced, and the premolars are $\frac{3}{3}$ (Fig. 23). The last premolars of both jaws are more or less like true molars. The inferior true molars support two V's, of which the anterior is the more elevated. A good deal of the skeleton of the *E. burmeisteri* Cope, is known. Its distinct scaphoid and lunar bones are represented in Fig. 24 *b b'*. It had five digits in the manus. The cervical vertebræ are more robust than the dorsal, and the tail is long and large. The characters of this genus approximate it to the true hedgehogs (Erinaceus), and I formerly placed it in the same order. The tritubercular superior molars separate it widely. Nevertheless I suspect that it stands in ancestral relation to the Erinaceidæ.

I have described five species of this genus, of which two are from the Wasatch of New Mexico, two from the corresponding beds of Wyoming, and one, *E. spatularius*, from the Wind River bed of Wyoming. *E. acutidens*, of the Big Horn region, is the largest, equaling a red fox in the size of the skull. The skeleton of *E. burmeisteri* shows, however, that, as in other Creodonta, the

limbs are smaller in relation to the skull than in modern Carnivora. The least species is the *E. acer* of New Mexico.

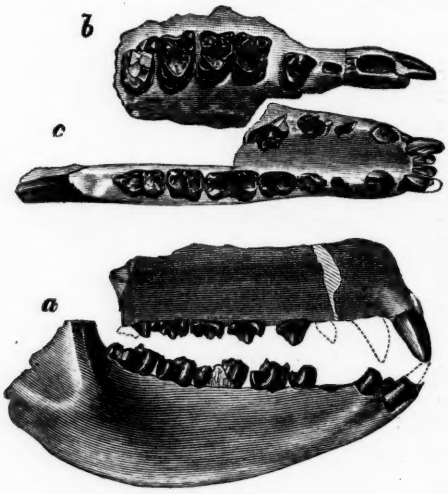



Fig. 23.

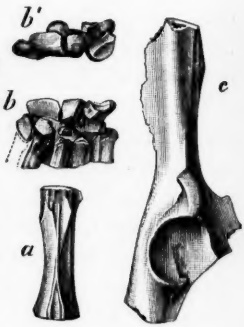



Fig. 24.

FIG. 23.—*Esthonyx burmeisteri* Cope, part of skull with lower jaw, from the Wasatch epoch of the Big Horn, Wyoming. two-thirds natural size; Fig. *a*, lateral view; *b*, inferior; *c*, superior views. The superior jaw consists of two pieces. FIG. 24, bones of specimen represented in Fig. 23, same proportions. Fig. *a*, caudal vertebra; *b*, carpus from front; *b'*, do. proximal view; *c*, part of innominatum, external view. Original, from the Report U. S. Geol. Survey Terrs., F. V. Hayden, Vol. III.

## OXYÆNIDÆ.

The genera of this family are best explained by the following analytical table. The pertinence to it of the genus Thereutherium Filh., is not certain. The only genera which present the character of the narrow transverse third superior true molar, are Oxyæna and Pterodon.

I. Inferior molars with three anterior cusps.

Cusps obtuse; fourth premolar with tubercular heel; formula $\frac{3}{3}\ \frac{3}{3}$.....*Palæonyctis.*[1]
Cusps acute; heel of fourth premolar cutting; formula $\frac{3}{4}\ \frac{3}{2}$.....*Oxyæna*

II. Inferior molars partly tubercular-sectorial, partly sectorial.

Superior molars unknown.....*Protopsalis.*

[1] These characters are derived from an examination of the type of DeBlainville, preserved in the Mus. Jardin des Plantes, which the permission of Professor Gervais enabled me to make. Other characters of the fourth premolar, which I have hitherto copied from others, are inexact.

III. Inferior molars sectorial.

Last superior molars transverse; others with two median cusps; formula $\frac{4}{3}$ $\frac{3}{3}$, *Pterodon.*

Last superior molar subround; others with one median cusp; formula $\frac{3}{4}$ $\frac{3}{3}$, *Thereutherium.*

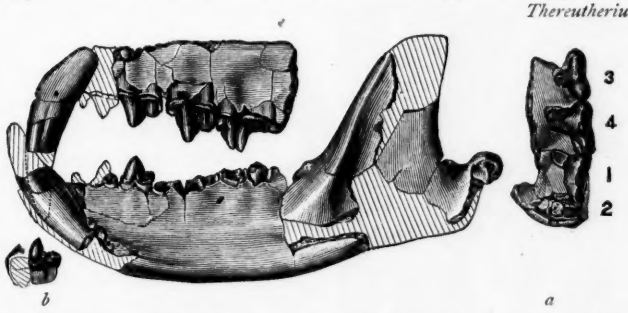



FIG. 25.—*Oxyæna lupina* Cope, jaws, one-half natural size, from the Wasatch beds of New Mexico. Fig. *a*, maxillary bone with teeth, from below; *b*, last superior molar, from behind. Original from the Report U. S. G. G. Survey W. of 100th mer., G. M. Wheeler.

Of the above genera Oxyæna and Protopsalis only are American. Thereutherium Filhol, includes a species, *P. thylacoides*, with a skull of the size of that of a skunk, which has been obtained from the Phosphorites of France. There are two species of Pterodon, both robust flesh-eaters. The *P. dasyuroides* of De Blainville is one of the longest known of the Creodonta. The *Palæonyctis gigantea* Blv., is found in the plastic clays near Paris. Its dentition approaches that of Amblyctonus.

The Oxyænas have the characteristic peculiarities of the Creodonta and of the carnivorous marsupials in their general proportions. The head was relatively larger, and the limbs were smaller than in true Carnivora. The feet were plantigrade, and had five toes anteriorly and posteriorly. The hind foot was either divided so that the external two toes opposed the internal three, or were divergent and connected by a median web. If not divided, the entire foot was directed outwards from the line of the calcaneum. In the latter case the hallux may have been opposable, as in the opossum, but in a much less degree. The tail was long and stout (Fig. 26).

Species of this genus were abundant during the Wasatch epoch in New Mexico and Wyoming, and probably over the entire continent. They have not yet been reported from higher Eocene beds, not even occurring in the Wind River. A small species is

found in the Puerco. A species (*O. galliæ*) has been recently detected in the Eocene of France by M. H. Filhol.

The dentition of the Oxyænas indicates sanguinary habits (Fig. 25). From the measurements, which are confirmed by more than one other skeleton, it can be seen that there is in the *Oxyæna forcipata* (Fig. 3, p. 260), a remarkable disproportion between the size of the skull and that of the limbs. While the dimensions of the jaws are like those of the jaguar, those of the limbs do not exceed those of the cheetah, while the digits are not only much shorter, as those of a plantigrade animal, but are more slender. The ungual phalange preserved, shows that the claws had no prehensile power, and were not effective as weapons or for digging. This is a further indication that the species of Oxyæna were aquatic in their habits.

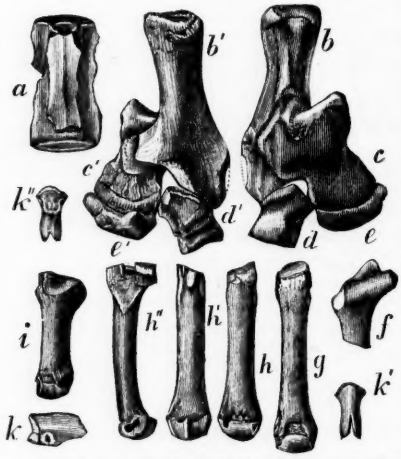



FIG. 26.— *Oxyæna forcipata* Cope, posterior foot and (*a*) caudal vertebra, two-thirds natural size. Figs *b*, calcaneum, *c*, astragalus; *d*, cuboid; *e*, navicular bone; from above; *b' c' d' e'*, the same from below. Figs. *f g h i*, metapodial bones; *k*, ungual phalange from above, right side and below. From the Wasatch beds of the Big Horn, Wyoming. Original, from the Report U. S. Geol. Survey Terrs., F. V. Hayden, Vol. III.

But one species of the genus Protopsalis is known, the *P. tigrinus* Cope, which shares with the *Mesonyx ossifragus* the distinction of being the largest of the Creodonta. It is from the Wind River beds, which possess a fauna mainly of Bridger character, but with an admixture of Wasatch forms.

The form of the sectorial tooth, together with that of the metatarsal, approximates this genus to the Felidæ more closely than to any other family of existing Carnivora. The resemblance seen in the sectorial (Fig. 27 *a*) is, however, probably delusive, as it is not the same tooth as the sectorial of the Carnivora. The resemblance in the metatarsal is real, as the characters are unlike those of Canidæ or Hyænidæ. The feet are evidently larger than in many of the Creodonta, as the proximal extremity of

the metatarsal is as large as that of a lion.

It is possible that the genus Patriofelis of Leidy belongs to this family, but its dental characters are not described with sufficient precision to enable this question to be decided. The inferior molar series is short, including, according to Leidy, only five teeth. The *P. ulta* Leidy, has a jaw the size of the puma. It is from the Bridger beds of Wyoming.

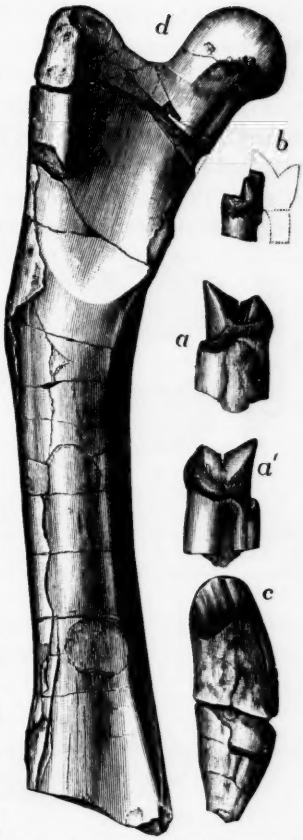



FIG. 27.—*Protopsalis tigrinus* Cope, one-half nat. size. Fig. *a*, probably last inferior molar, innerside; *a'*, external side; *b*, penultimate inferior molar, inner side; *c*, inferior canine, external side; *d*, femur, anterior view. From the Wind river of Wyoming. Original, from Report U. S. G. Survey Terrs., III.

### MIACIDÆ.

In this family we have the point of nearest approximation of the Creodonta and Carnivora. This is indicated by the fact that the sectorials of this family are true sectorials, both by position and form, such as are not elsewhere met with in the Creodonta. The genera might readily be taken for members of the Canidæ and Viverridæ, but for the structure of the astragalus, which is thoroughly Creodont. There is no trochlear groove of the tibial face, and in Didymictis it is so oblique that the internal malleolar face looks partly upwards. There are two genera known, Miacis Cope, with two inferior tubercular molars, and Didymictis Cope, with but one.

Five species of Miacis have been described, two of which are from the Wasatch and three from the Bridger beds. The former are distinguished from the latter by the larger size of the second tubercular molar, which has two roots. The later species, of which the type *M. parvivorus* Cope, is one, have but one such

root. None of the species exceeded the gray fox in size, and the Bridger species at present known, are much smaller.

Didymictis has a greater range in time than Miacis. Eight species have been described, two of which are from the Puerco horizon and six from the Wasatch. The genus is probably represented by other species in the Bridger. There are three divisions of the genus. In the first the premolars are not lobed on their posterior margins; here belong *D. primus* and *D. haydeni-*

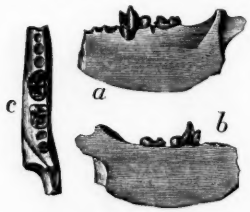



Fig. 28.

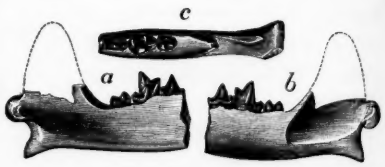



Fig. 29.

FIG. 28.—*Miacis brevirostris* Cope, left mandibular ramus, two-thirds natural size. Fig. *a*, left side; *b*, inner side; *c*, from above. From the Wasatch beds of the Big Horn. FIG. 29.—*Didymictis massetericus* Cope, left mandibular ramus, two-thirds natural size, from the Big Horn river, Wyoming. Fig. *a*, inner side; *b*, external side; *c*, superior view. Original, from the Report U. S. Geol. Survey Terrs., Vol. III.

*anus* (Fig. 30) of the Puerco. The others have the lobes in question, but two of them, *D. curtus* Cope, and *D. massetericus* Cope

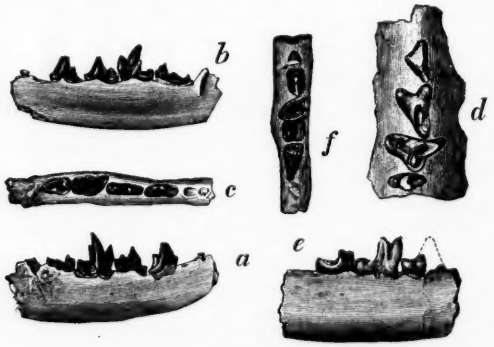


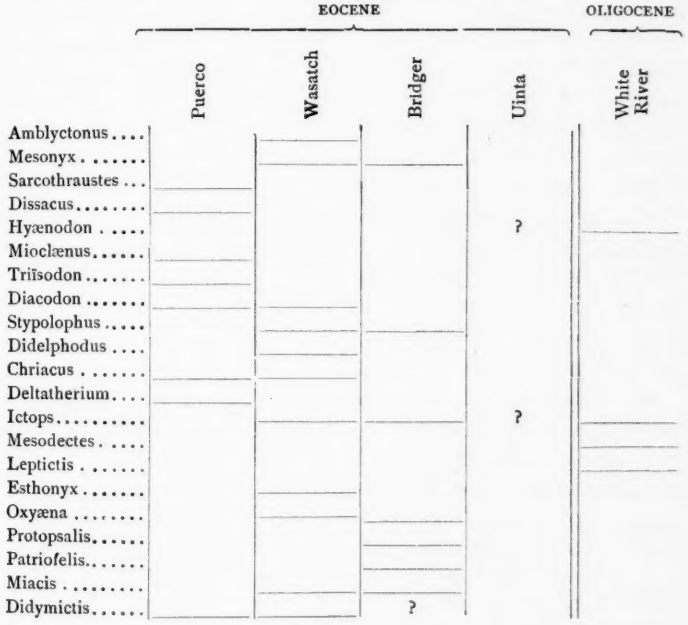

Fig. 30.

FIG. 30.—*Didymictis dawkinsianus* Cope, natural size; from the Wasatch beds of the Big Horn, Wyoming. Fig. *a*, external side; *b*, internal side; *c*, from above. Figs. *d*, *e*, *f*, *Didymictis haydenianus* Cope, jaws natural size, from the Puerco formation of New Mexico. Fig. *d*, maxillary bone with teeth, from below; *e*, left ramus mandibuli, inner side; *f*, do., from above. All original, and from the Report U. S. Geol. Survey, Terrs., F. V. Hayden in charge, Vol. III.

(Fig. 29), have a short subcircular tubercular molar, while that of

the other species is an elongate oval. The tendency in the genus has been to complicate the premolars and shorten the tubercular in the course of time. The smallest species is the *D. dawkinsianus* (Fig. 30), from both the Big Horn and Wind River beds, an abundant and acute-toothed species. The largest species is the *D. altidens* Cope, whose jaws are more robust than those of the coyote.

I append the following table showing the distribution of the genera of Creodonta in the North American Tertiary formations:

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## A WALK THROUGH THE NATURAL HISTORY MUSEUM AT FLORENCE.

BY JAMES S. LIPPINCOTT.

SOUTHWARD from the great Pitti palace in Florence, on the Via Romana, which, like all other roads, leads to Rome, stands a structure whose exterior is but an indifferent exponent of the treasures within. Unlike the palace near at hand, which

rises from cyclopean walls and spreads its wings grandiosely and lifts its vast stories forty feet in height, the structure to which we propose to introduce the reader, is unpromising in the extreme. The eye of architectural taste would appear to have been effectually closed while the façade was reconstructing, and every order and all order ignored. Windows of many forms and proportions have been thrown together as though they were the remnant of the stock of a dealer in old frames, and the singular effect thus produced must be seen to be fully appreciated. The inevitable barred windows in the piana terrena (ground floor) tell a story of former pretension to some dignity if not to opulent elegance, for the structure was once a palace. Though of unprepossessing exterior, this building is to us most interesting and attractive, and, we may add, one of the most creditable to the intelligence of Florence, not because of any treasures of art that it holds, but for its treasures of Science, its illustrations of her struggles and triumphs: "The life of nature is better than the dead bones of art."

Over a high portal and carriage entrance, observe an inscription and mark the purpose of this rude building, "R. Museo di fisica e Storia naturale." Behold, we are at the door of the Academy and Museum of the Physical and Natural Sciences, and are ready at once to enter. Within, a wide court open to the sky, appears, and lofty gray columns around sustain the heavy walls above.

We find ourselves in an old-time palace, fortunately no longer the abode of opulent imbecility, but devoted to noble purposes. We gaze around: what is that great black globe that stands solemn and alone in yon far corner of the colonnade? Approach! Some remnants of gilding, upon which a few faint lines appear, attest that it was once a terrestrial globe, and displayed, perhaps, all the geographical knowledge of the era which gave it birth. Alas! how sadly in eclipse does it now appear. That old globe has revolved upon its axis for three centuries, and owes its origin to Ignazio Danti, a Dominican monk, who made the astronomical instruments still to be seen on the façade of the Church of Maria Novella. It once stood in the Palazzo Vecchio, and having been fingered by thousands, until the boundaries betweeen land and sea were no longer discernible, was passed over to the museum and turned out of doors, happily, perhaps, for the reputation of the geographer of the Grand Duke Cosmo I., whose knowledge of the New World in 1550, must have been rather hazy. It how-

ever attests the acceptance of the theory that the earth is a globe, and that men can stand at the antipodes, though we find no Scripture authority for this belief, once esteemed the *unpardonable sin*.

A weather-stained bust of Galileo, green with abundant algæ, stands upon a pedestal at the rear of a court open to the sky, but in the halls above he is honorably enshrined.

Broad easy steps invite us to ascend—but stay! We cannot pass that colossal marble statue whose face bears the impress of questioning thought. We need no name beneath to tell us its significance, the siphon barometer in his hand and his earnest introversion assures us that it is Toricelli reflecting upon the vacuum that bears his worthy name.

Ascend—if you are a naturalist, or love the book of nature and would read her story—you need no further invitation. At the head of the first flight, doors open into the hall of the botanical museum, lecture-room and herbaria, which lie in succession beyond. On the left of the outer door stands a marble bust of Amerigo Vespucci, the appropriateness of whose position we did not discover. In the first hall large glazed cases line the walls, in which are displayed magnificent specimens of fossil palms, calamites, &c. Among these may be named *Phœnicitis vettinoides* from the Tertiary of Vegroni, three feet long; *Flabellaria major* from the Miocene of the same locality; *Latanites gigantea*, *Sassafras ferretianium* from Sinigalia; *Laurus oreodaphnifolia*, all from the Miocene of Italy; *Ficus tetrafolia* from Œningen, Switzerland. A photograph of the fossil *Pinites protolarix*, thirty-six feet in circumference, and now in the botanical garden at Breslau, hangs upon the wall.

Beyond the room we found a collection of natural vegetable products and illustrations of strange tropical and other plants of an extraordinary character, exceedingly interesting and apparently quite as complete as that at Kew. Here were exhibited, readily accessible, giant specimens of *Dicksonia antarctica*, split open to show the peculiar growth of this New Zealand tree-fern; the *Xanthorrhea arborea*, or grass-tree, of Queensland, Australia; *Raphia ruffia* from Madagascar, exhibiting remarkable clusters of obovate, brown, smooth cones from above large scales, leaf-like and singular; *Amorphophallus titanicum* from Sumatra, two feet high and eight inches in diameter, resembling a giant cluster of

ripening dates, an extraordinary product, preserved in spirits; *Macrozamia spiralis* from Melbourne, with its giant rhizoma, and others quite interesting and instructive. Large horizontal cases filled with Fungi in colored plaster, and the minute fungi which attack the vine and the rose, *Oïdium tuckeri*, &c., are represented in wax in gigantic proportions, the work of a master hand. A magnificent illustration of the structure of the flower of a gourd and the process of fecundation of an orchid are also to be seen here, and can be readily studied. These offer admirable subjects for class illustration, while they are attractive to the least scientific. The collection of specimens in these wall cases is rich in Coniferæ, and many of this family from California wore quite a familiar aspect. The wonderful Welwitschia from Africa may be seen among the Gnetaceæ upon these richly-furnished shelves.

On entering the halls, or saloons, containing the herbaria, my eyes first fell upon Loganiaceæ, named in honor of James Logan, of Philadelphia, the faithful friend and confidential agent of William Penn, one of the most learned men of his day and author of a treatise on the sexual character of *Zea mays* (Indian corn). This treatise (*Experimenta et Meletemata circa Plantarum Generationem*, 1739) was so far in advance of the age as to be rejected by the Philosophical Society of London, but having been printed by Dr. John Fothergill, at Leyden, it was admitted to be of great value to botanical science, which had not yet accepted the doctrine of the sexuality of plants.

With kind courtesy I was conducted by Professor Theodore Caruel, the learned director of the botanical department, through the great halls devoted to the preservation of the herbaria. These collections much exceeded my expectation, and the manner in which they are arranged should serve as a model for imitation by similar institutions. On shelves around the walls of the two large saloons, the fasciculi containing the dried plants are arranged in natural orders, and so classified that in a few minutes any specimen can be found; each is attached to its label, which is pinned to a sheet of stiff paper so that the plant can be examined and studied without detachment from its definitely ascertained name. The number of species here arranged is not yet known, since the collection is in process of reëxamination and enumeration by Professor Caruel. Here may be seen those presented to the museum by

Philip Barker Webb. This botanist had traveled extensively over a large portion of Europe and Asia Minor, accompanied by Berthollet, and together they published a volume on the Canary islands, where he had for several years resided. Having visited Florence, in 1848, he was so much impressed with the value of its botanical collection, and with the interest in the museum shown by the Grand Duke, that he bequeathed his rare herbarium to the prince, and endowed the botanical section with an annual income to aid in its extension. His botanical library of 5000 volumes is fitly arranged in an adjoining room, and ranges from Theophrastus to Gray, through Bauhin and Miller and the bulky Herbals, and long lines of the *Botanical Magazine* and many other serials. I was glad to see that several recent volumes of the AMERICAN NATURALIST, handsomely bound, had been added to the collection.

The herbarium of Webb is said to have contained eighty thousand specimens. What tales they could tell of wanderings in the far-away wilds in which they grew, of weary travel amidst deserts, forests, swamps and on Alpine heights, by enthusiasts prompted by the genius of science. None but the devotee to botanical research or the mania for collecting, can know the joys of the discoverer of unknown plants. To find a species hitherto undescribed, or better still, the representative of a new genus, with the faint hope that some light of botany may recognize his devotion and immortalize him by giving his obscure name thereto, thrills him with a joy unknown to common mortals. Webb is fittingly commemorated in a marble bust placed in the full light of a window, in the hall devoted to the display of vegetable products, and again on canvas in the gallery of his unique library. In the latter he is represented as a ruddy Englishman of honest, kindly, beaming countenance that glows with the enthusiasm that might have sat thereon while regarding for the first time some hitherto unknown plant in full flower.

Here I had the pleasure of looking through the oldest known herbarium,[1] that of André Cæsalpini, which, according to the

[1] This is the oldest known herbarium, unless the recently discovered garland on the mummy of Amenohotep I, be regarded in the character of a "hortus siccus." These garlands are, for the most part, in as perfect preservation as if in a herbarium. Among these ancient Egyptian plants, *Delphinium orientalis*, *Nymphæa cærulea*, *Nymphæa lotus* and *Carthamus tinctorius* have been satisfactorily determined from the petals and sepals which were found arranged in rows and attached to willow

dedication in his own handwriting, to his patron, Bishop Tournabuoni, was made in Pisa in 1563. This herbarium has been bound in three thick folio volumes, and contains 767 specimens of plants. One of them, however, proves to be a zoöphyte (Sertularia). No attempt at classification appears therein. Greek and Latin names are appended to many of the specimens, which are generally well preserved, though a few have disappeared. This herbarium has been ably described and catalogued by Professor Theodore Caruel, the learned director of the botanical department, in his work entitled, "Theodori Caruelii, Illustratio in Hortum Siccum Andreæ Caesalpini. Florentiæ, MDCCCLVIII." His dedication of this volume to his father's memory breathes so grateful a sense of filial regard, and is withal so beautiful, that we cannot refrain from presenting it to the reader. May it influence other parents to encourage their sons to pursue the noble paths of natural science, and thereby save many a youth from the snares that beset adolescense: "Tuo nomini tuæque memoriæ Constans Theodore Caruel, parens optime venerande cujus potissimum consensu et ope naturalium disciplinarum studia ab ipsa adolescentia excolui, primum huncce laborum meorum fructum pio gratoque animo volens libens inscribo."

In the cabinet which contains the precious herbarium above referred to, stand also upwards of sixty large folio volumes bound in parchment, a mode much in favor in Italy. These are the manuscripts, &c., of Micheli, many of which have not been edited. To this botanist we owe the discovery that Fungi are truly vegetable organizations, and several colored drawings of these plants may be seen in his herbarium. As he lived during the first thir-

leaves (*Salix salsaf*) by means of thread of the date-leaf, the whole forming a garland. The dried fruit and yellow blossoms of *Acacia nilotica* were also found, and on some of the other mummies fine detached specimens of blue and white lotus, with stem, blossom and seed-pods complete. Upon another was found a lichen (*Parmelia furfuracea*), a plant indigenous to the islands of the Greek archipelago, and which must have been brought to Egypt B. C. 1100 or B. C. 1200. It is sold by the native druggists at this day.

These frail relics of the past have been arranged for the Boolak Museum, classified, mounted and illustrated by modern examples of the same flowers and plants, and fill eleven cases—an unique collection. The hues of these old-world flowers are said to be as brilliant as those of their modern illustrators, and were it not that the tables show them to be 3000 years apart, no ordinary observer could distinguish between those buried with the Pharaohs and those gathered and dried but a few seasons since.

ty-seven years of the eighteenth century, he was a precursor of Linnæus. Busts in marble of the elder De Candolle and of Micheli adorn this cabinet—the first of massive feature, the latter keen of aspect with his aquiline nose and cowled brow.

In addition to Webb's vast collection there may here be seen the plants of Pavon from Chili and Peru, those collected by Labilliardiere, who accompanied La Perouse to New Holland, and of Desfontaines and Mercier in Tunis and Algeria. Labilliardiere having been taken prisoner by the Dutch and his collection brought to England, it was, through the generous intervention of Sir Joseph Banks, restored unopened, "lest," as Sir Joseph wrote to Jussieu, "a single botanical thought should be taken from him who had gained them at the expense of his own life." Noble Sir Joseph!

The Florentine museum is rich in fossil plants, some of which, it is said, are not represented in other cabinets of Europe. Among the 4000 valuable specimens the more noteworthy are from the Carboniferous near Volterra, and fossils from Sinigaglia, the Miocene of Tuscany and the Permian of the Brescian territory and a splendid collection of palms from Verona and Vicenza, and impressions of plants from the lava of Lipari. A great collection from the Miocene of Switzerland, illustrated by Dr. Heer, is also exhibited conspicuously.

One of the early and earnest co-laborers in the department of science, was Dr. Targione Tozzetti,[1] grandfather of the present distinguished Professor Targione, director of the invertebrate section of this museum. At the age of twenty-three he was appointed professor of botany under Micheli at Pisa, and afterwards director of the botanical gardens at Florence. He was also librarian of the Magliabecchian library, and arranged the vast number of volumes bequeathed to the city by the eccentric collector and wonderful linguist whose name it bears. Dr. Targione Tozzetti traveled through Tuscany collecting materials for his great work on the agriculture, natural history, art and antiquities of his native country, but the more important work of this man of encyclopædic mind, was his last, on the Progress of Physical Science.

In the botanical museum Professor Parlatore, the late director

[1] Professor Targione Tozetti and Micheli have received fitting commemoration in Santa Croce, the Westminster Abbey of Florence.

of the botanical department, is commemorated in marble, and stands in friendly opposition to the generous enthusiast Webb.

A walk through the botanical gardens and greenhouse proved very interesting; the former especially, since it served to indicate the character of the winters that have permitted *Chæmerops humilis* to grow thirty feet high in the open air, grand clumps of *Nerium oleander* to flourish unscathed, and giant *Lagerstræmia indica*, rivaling our quince trees in size, to exist without protection. Pampas grass also endures the winters here unguarded from snows and cold. The Botanical gardens adjoin the Boboli garden of the Pitti palace, but are not generally open to the strolling visitor. A much larger space has recently been devoted to the construction of new gardens for the scientific arrangement and study of plants, which lies near the "Institute for higher studies" on the Piazzo San Marco. The street upon which it opens is appropriately named Via Micheli.

Passing for the present the grand Tribune of Galileo, which is entered at the western end of the corridor, the middle door of which has given us access to the Botanical hall, let us ascend to the second piana (the third story of the American). Before us, over the entrance to a series of rooms, we read, "Regno Animale," and observe on the right a marble bust of Fontana, the early scientific projector and arranger of this museum, and on the left a bust of Leopold I., the then reigning Grand Duke of Tuscany, whose warm interest in science made him its liberal patron. A wide doorway invites, through which we discern others opening between successive minor departments, whose walls are covered with glazed cases, in which are exhibited a large collection of objects of scientific interest. We enter unchallenged by the guard, and are within a small room devoted to zoöphytes, and find ourselves at the base of the scheme of animal existence, or at that section of it that can be illustrated by mural specimens for popular instruction.

Having entered, we quietly soliloquize—here we have found a museum in which some presiding mind has guided the exhibition of the myriad objects that compose it. "Has any seen the mighty chain of being, lessening down from Infinite Perfection to the brink of dreary nothing—desolate abyss?" has often run through my memory, and never before did I imagine I had come so near to finding an answer to my query. As we pass onward,

insects, and some of their products appear, among which we notice the remarkable web of the *Tinea granella*, or granary moth, which most resembles a sheet of white tissue paper, two feet high and one foot in width. Enormous crustaceans, spiders, &c., may next be seen, all brought so near to the observer that he can study them readily. We soon find that we are following a *linear* arrangement, a system of classification which modern research and wider philosophy have shown is but an imperfect illustration of the thought of the Creator.

Many learned naturalists have labored at the construction of systems of classification, but each succeeding scheme has given way before increasing knowledge of the relations of groups. Whether we suppose relations represented in a linear arrangement or in a circular one, in which circle touches circle within circle, or as a sphere in which is contained a multitude of minor spheres representing classes, groups or genera touching on many sides —all have proved artificial, all have failed to reflect the facts of nature, as later insight has proved them to be mutually related. The *key* to the cause of the multiplex relations of animal forms not having been found, every effort to present them aright could but prove unsuccessful. Recent discoveries in embryology and palæontology, having thrown a flood of light upon the intricacies of this question, by their wonderful illustration of the doctrine of development *arrested* and *accelerated;* the *key* to a correct system of classification in the vegetable and animal world, it is believed has at length been placed in our hands.

The study of living forms alone cannot guide us to the construction of a system that shall explain the relations of genera in the animal and vegetable worlds. As the relation between the living men and women of this generation can only be satisfactorily illustrated by tracing their respective genealogies back to some common ancestry, from which they have derived their similarity of physique, physiognomy or mental traits, and their minor diversities, so we must discover and study the originals which gave rise to the multiform representatives of ages of development therefrom, as found in the genera and families in the world of nature at large. Palæontology, therefore, becomes a guide to the determination of the order of successive forms through which the predecessors of the living plants and animals have passed. A more profound acquaintance with those ancient forms, and with

the changes through which they have passed, is demanded before a system can be made, perfectly adapted to the illustration of the infinite modifications of the living. How widely has expanded the range of the science that was once thought only worthy of triflers and silly enthusiasts! It has become co-extensive with the origin and destiny of all things, its limits are time, its range the universe; its philosophy, all-comprehensive, is bound up with human progress and human destiny.

But we will not longer detain the visitor anxious to advance. From enormous crustaceans we proceed directly to mammifers and the skeletons of birds, &c. Not such is the order of nature, we observe, and retire upon our philosophy to wait until evolution shall have prepared for us the system that will show us how from the lower forms sprang fishes, from fishes reptiles, from reptiles birds, and how from batrachians were produced higher forms, culminating in mammifers and eventually in bimana and hence man. We gladly acknowledge that an outline of this system has been effectively foreshadowed.

In a large room the birds, ever pleasing, are displayed to advantage, not being crowded into limited space, as is our unrivaled collection in the "Academy of Natural Sciences" in Philadelphia. In another section Dr. Enrico Hillyer Giglioli, professor of zoölogy in the "Royal Institute for Superior Studies," and director of the Museum of Zoölogy, has prepared and arranged in a suite of noble saloons, a nearly complete exhibition of the fauna of Italy. This is the first of its kind for an entire kingdom that I have seen, and I found it a very striking and rich treat.[1]

[1] This grand central collection of Italian vertebrates contains, at the present date (May, 1883), 22,331 specimens of 1139 species of Italian animals. Of these there are 1500 mammals representing 108 species, and the collection is pronounced complete. There are 2200 specimens of birds representing 415 species, which nearly complete the series. Reptiles number 2754 specimens of forty-one species, which complete the series found in Italy. Of Amphibia there are 1830 specimens of twenty-one species, and this number includes every known species in the kingdom. Finally, there are the vast number of 14,048 specimens of fish, representing a collection of 554 species, which is pronounced nearly complete.

To Professor E. H. Giglioli we are indebted for the discovery of an ocean fauna in the Mediterranean. It was during his researches in the steamer *Washington*, a government vessel commissioned for deep-sea dredging, placed at his disposal, that he made the important discovery above stated in August, 1878. His announcement of this discovery appeared in *Nature* of 25 Aug. of that year, and his report was published in the "Acts of the Third International Geographical Congress," Vol. II, Venice, 1881.

Professor Giglioli is a genial gentleman of English and Italian parentage, and his language proves that he learned it at his mother's knee. His collection is worthy of the highest commendation, and his success should stimulate other kingdoms and peoples to emulate the example of Italy. To the generous kindness of Professor Giglioli I must acknowledge my indebtedness for many courtesies.

The anatomical preparations in this museum are interesting and of extraordinary character, unrivaled elsewhere. The art of preparing waxen models so that they can scarcely be distinguished from natural objects was brought to perfection by a Sicilian noble of Syracuse, named Zumbo, who was born in 1656. The report of his wonderful skill having reached the Grand Duke Cosmo III., Zumbo was invited to Florence. He afterwards left Tuscany for Marseilles, where he was patronized by Louis XIV., and died in 1703.

The waxen preparations exhibiting the internal structure of the Torpedo, are wonderfully life-like, having the appearance of real flesh. They illustrate the experiments made by Tain and Matteucci in animal electricity. Here are also magnified illustrations of the anatomy of the lobster, cuttle-fish, earth-worm and tongues of mollusks, the latter in gigantic enlargement. Also the internal anatomy of the silk-worm, of the domestic cat, goat, rabbit, cod-fish, and the several stages of the development of the chick from the egg of a hen, through the twenty-one days of incubation. The muscular fibers and tracheæ of a common fly are magnified 900 diameters or 729 million times in volume. This exhibit is one of the most remarkable evidences of the transcendent skill of the artist.

In adjoining rooms are displayed, of life size, a multitude of illustrations of human anatomy. In one, the arteries of the entire frame are represented in true color, form and place, standing out alone; and in another the veins appear by themselves, while in a third the arteries and veins are seen with all their intimate interosculations. In a fourth the observer is introduced to his nervous system, and its wonderful net-work of white cords is seen interlacing and enveloping the entire anatomy of veins, arteries, bones and muscle, the skin alone having been removed. Every stage of dissection is illustrated, every organ is represented, from the hair to the toe-nails, and the visitor might for a moment imagine him-

self transferred to the midst of a dissecting-room with all its ghastly surroundings. His consciousness that these animal forms and repelling developments are but waxen models, preserves him from losing his equilibrium, or he would be prompted to flee in horror from the scene. The sickening exhibition of several stages of the progress of the plague, that once disgraced this series with its disgusting details, with other preparations, thanks to an awakened sense of propriety, have been removed to a private room.

The value of these models can scarcely be deemed commensurate with the expense incurred in their preparation. Many, however, who would not enter a dissecting room, who could not contemplate the real organization, may here learn much respecting their internal economy—learn that they are "fearfully and wonderfully made." It cannot be of equal service to him who would know the inner workings of the human machinery, since he can be satisfied only by the dissection of the structure once endowed with life. It were better to limit their examination to the select few, rather than expose them to the gaze of the frivolous and debased.

The palæontological collection was formed by order of the government from material already in the museum, with additions made thereto in answer to resolutions passed by the third Scientific Congress held at Florence, which recognized its value and recommended the enlargement by an exhibition of representative minerals and geological specimens from all parts of Italy. The collection having outgrown the limits of the museum on the Via Romana, was removed to extensive rooms on Piazza San Marco, where also is located the "Royal Institute for Higher Studies," established since the accession of Victor Emmanuel in 1861. Chairs of geology, metallurgy and mining were then established, under the charge of competent professors, for a new life has been breathed into Italy.

This museum abounds in fossil mammals from the valley of the Upper Arno, and has also numerous fossils from the Cretaceous. Some of the elephants are truly colossal, rivaling the mightiest mastodon of North America, specimens of which also are here exhibited.

Elephants must have abounded in the upper valleys, and the abundant remains of this species and of rhinoceros, hippopotamus, found in a deposit that probably once formed the bottom of

a fresh-water lake, indicate that their carcases were washed there by the flowing waters, and sank eventually to its bottom. The mammals of this section have been studied by Dr. Falconer, who has published numerous observations thereon. Among the more interesting may be named *Elephas meridionalis* (Nesti), *Rhinoceros etruscus* (Falconer), *R. megarhinus* (Christolf), *Hippopotamus major* (Cuvier), *Bos etruscus* (Falconer), *Equus stenonis* (Cocchi), *Cervus dicranios* (Nesti), *C. ctinoides* (Nesti), and *Bos primigenius* (Blum.).

This museum has known its seasons of struggle with adverse circumstances, connected with the rise and fall of rulers during the latter part of the last and early in this century, and was not placed upon a firm foundation until the establishment of Victor Emmanuel upon the throne of Italy in 1861.

Credit is due the Grand Duke Leopold of Tuscany, who employed Fontaina to collect objects illustrative of natural history, purchased the palace of the Bini and opened the museum to the public in 1780. During the days of Bonaparte ascendency, the new Queen of Etruria added a school of "public instruction" and founded chairs in astronomy, physics, anatomy, zoölogy, mineralogy, botany and chemistry, which was maintained for seven years, until the downfall of the Napoleonic kingdom and restoration of the Grand Duke, when the school was suppressed. Nearly twenty years passed, and it was revived, and again at the accession of Victor Emmanuel, when the institution for more advanced studies was founded, and chairs of geology, metallurgy and mining were added, and courses of lectures annually delivered.

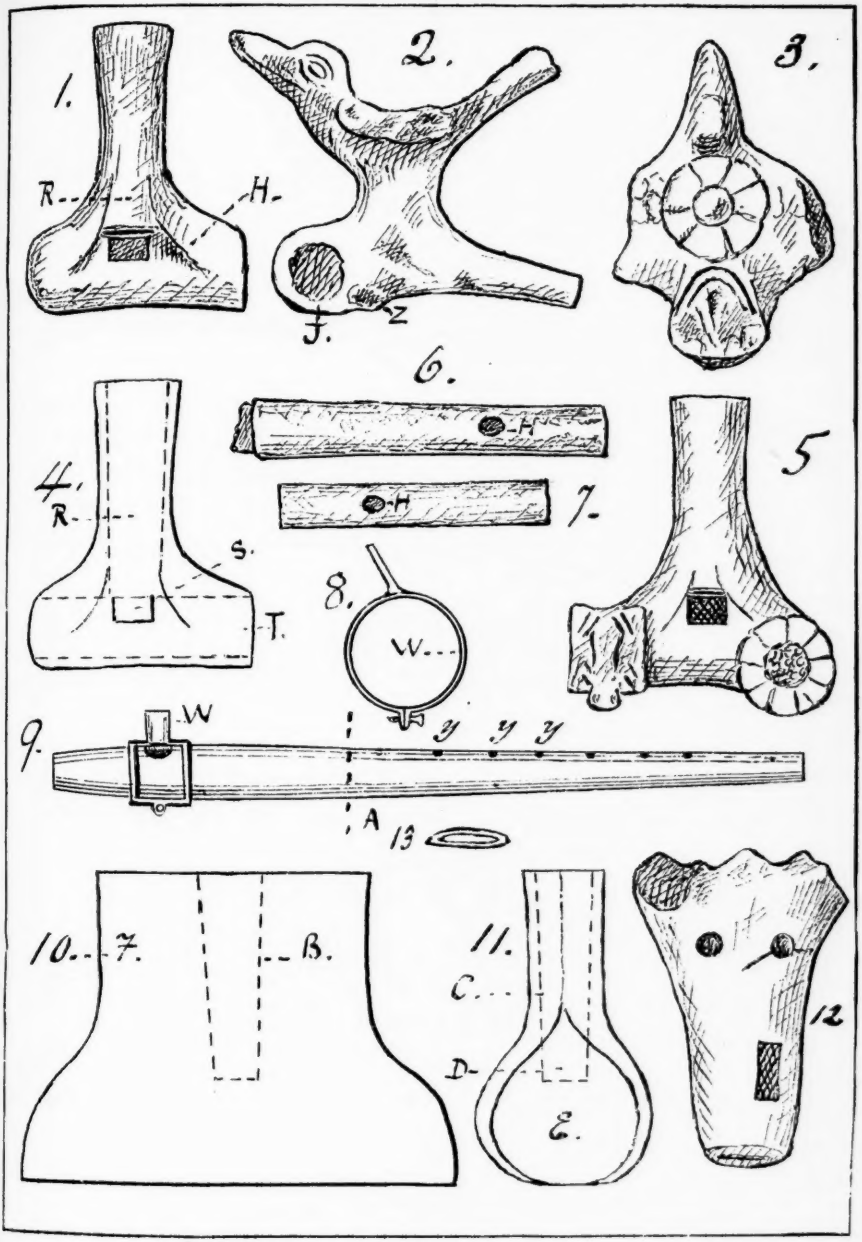
The shackles of spiritual tyranny having been unbound and the equally hard bands of classical devotion loosed, Italy has at length let in the light her unwise rulers sought to hide, and a new life is stirring in the veins of her children. If true to herself, and in the employment of her opportunities, if earnest in efforts for wider culture, and wise in her choice of science as the intellectual trainer of the growing mind, and if open to the reception of a sound Christian faith, attended by a corresponding advance in her moral sense, she may happily take again the place she once had as the first among the nations.

# CONSTRUCTION OF ANCIENT MEXICAN TERRA-COTTA PITCH-PIPES AND FLAGEOLETS.

BY H. T. CRESSON.

THE smooth internal structure of the pitch-pipes[1] and flageolets of baked clay, or terra-cotta, manufactured by the ancient Mexican potters, suggest that they have been modeled upon forms of some material capable of receiving a high degree of polish, probably bone or wood. The pitch-pipes shown in Figs. 2–5 (Plate XVI) have been made in this way, and are the most ingenious specimens of aboriginal plastic art in the collection of musical and other Mexican antiquities made by the Honorable J. R. Poinsett, United States Minister to Mexico in 1830. Figs. 1 and 2 (Plate XVI) are the front and profile views of a pitch-pipe, which is more primitive in style of construction than those shown in Figs. 1, 3, 5, 6 (Plate XVII), hereinafter described. An analysis of its construction shows that it has been made in three parts, viz., a clay reed, Figs. 1, R, 4, R (Plate XVI), a neck-piece or flap, Fig. 10 (Plate XVI), and a body, Fig. 4, T. A careful piece of workmanship is shown in the modeling of the first-named portion, or clay reed, Fig. 4, R, by means of which the air from the lungs of the performer is conveyed into the sound hole, Fig. 4, S, thus communicating with the body of the instrument, Fig. 4, T. This part measures one and three-quarter inches in length, by half an inch in width at its broadest portion (mouth-piece), gradually contracting as it approaches the sound-hole, Fig. 4, S, to about six-sixteenths of an inch. These measurements have been made from thirteen different clay reeds, and in the average, vary but little from one another. A section made through a neck-piece, parallel to the opening of the air passage, shows that the form upon which the clay reeds, Figs. 1, R, 4, R (Plate XVI) were modeled, had the shape of a thin, elongated wedge, an outline of which is given by the dotted lines in Fig. 4, R. The flaps, Fig. 10, F, were then cut out of clay rolled thin,

[1] As the instruments which are denominated pitch-pipes have heretofore generally been called whistles, it will be necessary to state that since the discovery of their musical powers (most of the retort-shaped pipes in the Poinsett collection possess stop-holes which, when closed, change the pitch of their respective instruments), it will be impossible to class them as such. The name pitch-pipe has, therefore, been adopted. See "Musical Instruments in the South Kensington Museum," by Carl Engel, page 285. (1385–'64.)

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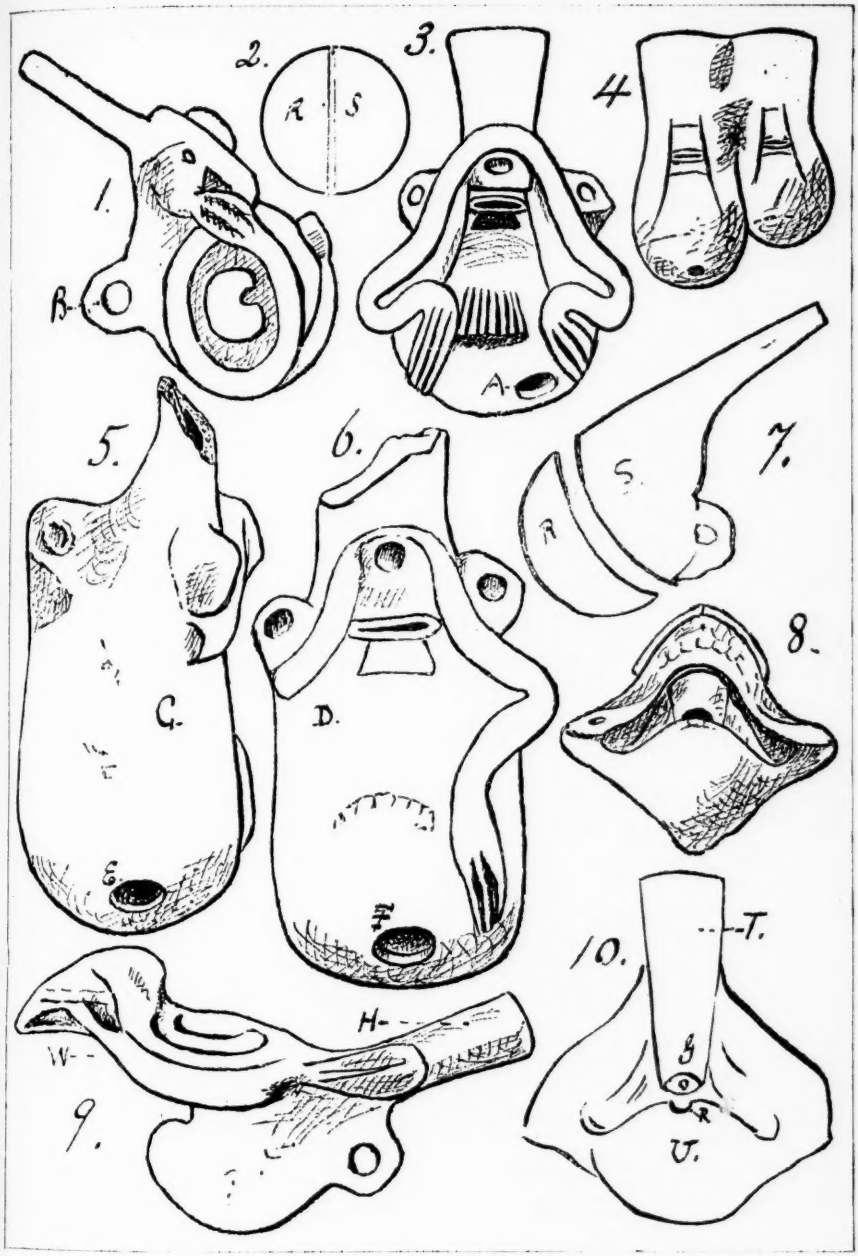
similar in shape to the outline shown in Fig. 10, and the clay reed, Fig. 10 B, enveloped therein. The dotted lines in Fig. 11 C, represent the clay reed, Figs. 1 and 4 R (Plate XVI), after the flap Fig. 10 F, has been modeled around it. This, it will be seen, divides into two portions a little distance above the narrow end of the reed, Fig. 11 D, which overlies the sound-hole upon the body portion, Fig. 4 S, running to either side and protruding beyond its terminal portion about two and a-half inches. This forms the notch into which the body of the pitch-pipe is introduced, Fig. 11 E (Plate XVI). A view of a section of the clay reed, made parallel to its aperture, Fig. 13 (Plate XVI), shows the exact size and shape of the air-passage. Specimens of these instruments, which have been detached in sections, suggest that this covering of the clay reed by the flap, Figs. 10, F and 11, C,[1] was accomplished while the reed was in a semi-dry condition. In order to understand the method pursued in joining earthenwares that have been made in pieces, it will be necessary to consider briefly the processes of our modern potters. Fictile wares, modeled upon the wheel or lathe, at a certain stage of the drying process possess a greater tenacity than at any other time, until they are baked—this is called by potters the green, or semi-dry state. While in this condition they are attached to the lathe by a little moisture, and turned nicely into the proper shape. This same degree of dryness, which admits of the clay being turned on the lathe, serves for attaching the handles or other appendages to earthen vessels. The parts to be attached, having been prepared, are joined together by means of liquid clay (called slip, by the potters), and the seams having been smoothed off and finished by careful modeling, are then ready for the kiln, which is to convert the tender clay into the hard biscuit. Having thus explained the way of making jointures while the clay is in semi-dry condition, it may be inferred, as the process of the ancient Mexicans did not in all probability differ essentially from those used by our modern potters, either in material or other methods of manufacture, excepting of course the use of the lathe, that these old potters used the semi-dry state to cover the clay reed with the clay flap, in order to avoid compressing the air-passage (which is very narrow, see Fig. 13, Plate XVI, where exact size thereof is given), at the

[1] The dotted lines in Fig. 11 C (Plate XVI) show the outline of the clay reed when covered with the protruding end thereof, Fig. 10 D (Plate XVI).

same time, allowing the form to be withdrawn before the clay reed had become hard and brittle. A section of the body portion of a pitch-pipe, like Fig. 4, R, T (Plate XVI), shows the shape of its interior, indicating the use of a cylindrical form, about two inches in length, upon which this portion, one and three-eighth inches long, was modeled. One end of the barrel is closed by a stopper of clay, the other remaining open.[1] The careful finish noticeable in the interior of all these musical instruments, forms a striking contrast (especially in the more primitive specimens, Figs. 1, 2, 5), when compared with the rough modeling of their exterior portions; this would be absolutely necessary, as any imperfection therein would interfere with the accuracy and quality of the tones emitted. A decided advance in the construction of primitive musical instruments was made by the ancient Mexicans beyond the simple tube or whistle, when their artisans produced such forms as Nos. 1, 2, 5 (Plate XVI). Take, for example, some of the primitive forms of whistles without finger holes, exhibited in the collections of the Smithsonian and Peabody museums, Figs. 6 and 7 (Plate XVI), which have already been described by Dr. C. C. Abbott in the United States Geographical Surveys west of the 100th meridian, p. 235 (illustrations Nos. 115, 116, 119 of that work). These, when applied to the lips and a current of air was impelled therein from the lungs of the performer, were no doubt (while in a perfect condition) capable of producing certain shrill notes. Blowing through a very small aperture of the lips against the edge or orifice of the sound-hole, thus directing the wind chiefly within the tube, naturally requires more practice in order to produce different notes. An invention was devised by the ancient Mexicans to overcome this difficulty of labial manipulation, by means of which the sounds were made even and regular, and were easily produced. The modern fife is sometimes furnished with a mouth-piece similar to that shown in Figs. 8–9, W (Plate XVI), which directs the current of air from the lungs of the performer, thus requiring less skill and labor to produce the requisite volume of sound. It will be seen that this mouth-piece, Fig. 9 W (Plate XVI), used upon the fife, is similar to that portion of the pitch-pipe which has been denominated the neck-piece, and is

[1] When the pitch-pipe is blown into, by stopping the aperture of the barrel with the finger, a note one-fourth lower than that given while open, is produced. (See Proceedings of the Academy of Natural Sciences of Philadelphia for 1883, p. 86. Aztec Music.)

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attached to the body portion of the terra-cotta pipe, shown in Fig. 4, T, by means of the notch formed by the clay flap in enveloping the clay reed, Fig. 11, E[1] (Plate XVI). A good illustration of this can be made by attaching a metal mouth-piece to one of our modern fifes, Fig. 9 (Plate XVI), and then sawing it asunder between the sound-hole, Fig. 9, W, and the finger perforations, Fig. 9, Y, Y (shown by the dotted lines). This having been done the result would be an instrument similar to Figs. 1 and 4 (Plate XVI).[2]

A pitch-pipe, showing an advance in construction upon that already described, resembling somewhat a retort in form, is shown in Figs. 1–3 (Plate XVII). It is modeled in four pieces, and the clay reed has been made in the same manner as those upon the sections shown in Figs. 10 and 11 (Plate XVI), differing only in the form of the body, which is circular. In order to accomplish the modeling of the body portion, it would be necessary to use a circular form, dividing it into two portions, Fig. 2 (Plate XVII), one half being modeled on one portion, Figs. 2, R (Plate XVII), and the other half upon the other side, Figs. 2, S (Plate XVII). The two halves being made so as to correspond nicely when joined together. The double pitch-pipe, shown in Fig. 4 (Plate XVII) demonstrates that this method was pursued, from the fact that while in the kiln the two halves which compose the body have been separated by the action of the heat, thus showing its construction. By careful examination traces of this jointure can be seen in some of the pitch-pipes, although in most cases it is impossible to detect it, so nicely have the marks of jointure been concealed by skillful modelings. Each one of the retort-shaped instruments, Figs. 1–3 (Plate XVII) is pierced by a stop-hole,[3] Fig. 3, A (Plate XVII), which is placed to the left hand side of a line drawn longitudinally around the body of the pipe, passing through the center of the sound-hole (holding the neck-piece toward the

[1] The fact must not be overlooked that the clay reed is enveloped by the clay flap, these two parts constituting the neck-piece.

[2] The clay reed, Fig. 1, R (Plate XVI) attached to the body of the ancient Mexican pitch-pipes of terra-cotta, Figs. 1 and 2 (Plate XVI), by means of the clay flap, Fig. 10 F (Plate XVI), resembling the mouth-piece of our modern fife, shown in Fig. 9 W, is therefore an invention of our North American aborigines.

[3] When the stop-holes are left open in the right-angled and retort-shaped pipes, Fig. 1, R (Plate XVI) and 1–3 (Plate XVII); if the instruments are blown into, notes one-fourth above those given when closed are obtained in all the pipes excepting the No. 8 or octave pipe, which gives the interval of a fifth.

performer. Underneath the retort-shaped pitch-pipes, close to where the neck-flap and body are joined together, Fig. 1, B (Plate XVII), there is generally a button of clay, pierced by a hole through which a cord might be passed, forming a loop for suspension, or to attach it to the body of the musician. The primitive pipes shown in Figs. 1 and 5 (Plate XVI) do not have the button attached, but are pierced by a hole, used for a like purpose, made through the thick part of the neck-piece, Fig. 2, Z (Plate XVI), near to its jointure with the body.

A large pitch-pipe, Figs. 5–6 (Plate XVII), the character and outline of which are admirably shown by the artist, has been found among the specimens of the Poinsett collection since the publication of an article upon Aztec music by the Academy of Natural Sciences of Philadelphia. The instrument in question, Figs. 5–6, is pitched in the scale of A (three sharps compared with the flute), and the construction of the neck-piece and other parts differs but slightly from those already described. The body portion, Fig. 5, C and 6, D (Plate XVII), is considerably elongated and well adapted to produce the rich, mellow sound which it emits when blown into. Traces of jointure in this specimen are admirably concealed, and demonstrate that the body of the instrument was made in two pieces (upon a form) similar to that shown in Fig. 7, R, S (Plate XVII), although much more elongated. The body is pierced by a stop-hole, Figs. 5, E and 6, F (Plate XVII), like other pipes, and may be classed, on account of its construction and the grotesque decoration of its exterior, with those of retort-like form, shown in Figs. 1–3 (Plate XVII).

The construction of the Aztec pitch-pipes in the Poinsett collection of antiquities having been described, it will be necessary to say a few words upon their progression from primitive instruments, which it may, in all reason, be assumed were produced as among other barbarian nations, while their ancestors were in a savage state. As shells pierced by sound holes, and hollow tubes of bone or cane (without finger holes) were in all probability the most primitive instruments manufactured and used by the ancestors of the Aztecs, it may readily be granted that these, however rude when first invented, gradually improved as they advanced toward the middle status of barbarism. The primitive whistles already mentioned, Figs. 6, H, 7, H (Plate XVI), which were exhumed from the graves of the savage tribes who inhab

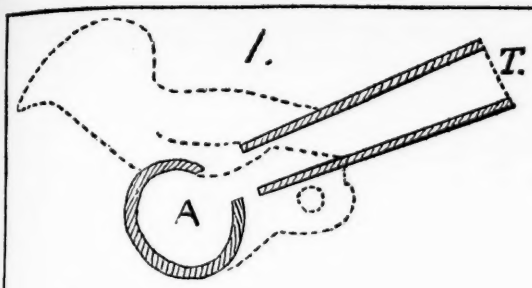
ited the coast of California, may be taken as examples of progression and improvement upon the simple tube and whistle of bone or cane, from the fact that they possess sound-holes, Fig. 6, H, 7, H (Plate XVI) cut for labial manipulation. The clay reed or neck-piece, Figs. 4, R, 11, C (Plate XVI), which resembles the neck-piece of our modern fife, Fig. 9, W (Plate XVI), was probably thus invented, and when attached to the primitive whistles (like those, for instance, found in the graves of the California coast), increased the volume and regularity of sound, forming the simple mouth-piece whistle without a stop-hole. This afterwards became the right-angled Aztec pipe, shown in Fig. 1 (Plate XVI), an end of which was left unclosed (see profile view of pitch-pipe, Fig. 2, J (Plate XVI), a strong proof that its inventor sought diversity of sound. The artisan who designed these ancient Mexican instruments evidently sought to improve their qualities of sound, which at first were shrill and cacophonous. To overcome this defect, the body of the right-angled pipe, Fig. 1 (Plate XVI), was expanded into a globular shape, placed parallel to and in front of the clay reed, and then pierced by a stop-hole, thus producing the pipe, Fig. 3, A (Plate XVII). This stop-hole, which first appears in the right-angled pipe, Fig. 2, J (Plate XVI) as before shown, is a most important step in the development of musical sounds among the Nahuatalacs, as it can be manipulated by closing and opening the same, thus depressing or raising the pitch of the instrument. These stop-holes, doubtless, suggested to the terra cotta instrument-makers of later date their gradual adoption as finger-holes. It is interesting here to remark the increase in volume and sweetness of sound that had been obtained by the ingenious Nahuatalac clay-worker or musical artisan, by elongating the body of the retort-like pipe, shown in Figs. 1 and 3 (Plate XVII), although it produced a somewhat unwieldy, still not ungraceful, instrument, Figs. 5–6 (Plate XVII), which is narrowest at the end of the body nearest the stop-hole, Fig. 5, E (Plate XVII).

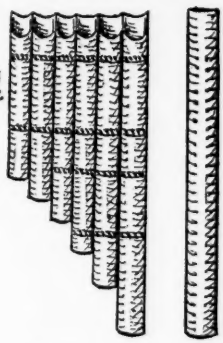
A specimen not unlike this last-named instrument was found upon the Island of Ometepec, in the Great Lake of Nicaragua, by the late Dr. Carl Hermann Berendt; a drawing of it is given by Mr. Barber in his valuable article upon "Indian Music, published in the AMERICAN NATURALIST of March, 1883. The elongated pitch-pipes, Figs. 5–6 (Plate XVII), are perhaps an intermediate form of pipe, between the retort-shaped instruments, Figs.

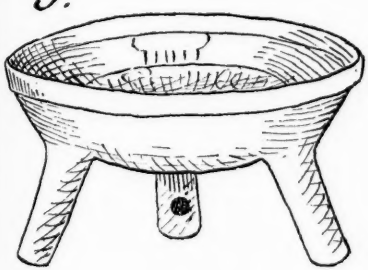
1–3 (Plate XVII), and the four-holed Tezcucan flageolets,[1] whose musical instruments probably attained the highest degree of perfection known to the Nahuatalacs.

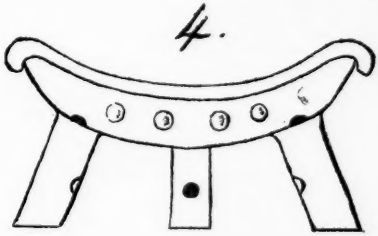
Karl Engel, in his "History of the most ancient Musical Instruments," demonstrates that among ancient nations of the Eastern continent, wind instruments were gradually improved in construction and power of sound. He mentions a pipe found by Captain Willock in the ruins of Babylon (Bis-Nimroud), as follows: "It resembles somewhat the flageolets and whistles of clay found in Mexico and Central America." The pipe in question, Fig. 12 (Plate XVII), copied from Engel's work, "is about three inches in length, and has only two finger-holes, placed side by side, and consequently equidistant from the end at which it is blown. The opposite end has no opening, the instrument, in this respect, resembling a whistle. If both finger-holes are closed it produces the note C; if only one of them is closed it produces E; and if both are open it produces G. Besides these notes one or two others are obtained by some little contrivance; thus by blowing with unusual force the interval of a fifth G may be raised to that of a sixth A, but the fixed and natural notes of the instrument are only the tonic, third and fifth. It is remarkable that the third, which is obtained by closing the left finger-hole, is about a quarter tone lower than the third which is obtained by closing the right finger-hole. Perhaps it was intended for the minor third. This is, as far as I am aware, the oldest musical instrument hitherto discovered which has preserved its original condition, yet it is constituted of so fragile a material that were it to fall from the hand to the ground, it would most likely be destroyed forever. But its notes cannot have been clearer two thousand years ago than they are at the present day. The shape of the instrument appears to be intended to represent the head of an animal. This interesting relic, described by Engel, is not unlike the Aztec pitch-pipes, and like the Mexican pipe shows how the simple

[1] The four-holed flageolet of terra-cotta, shown in the plate, was found near the city of Tezcuco, and is probably of Aclolhuan origin, a people whom we are led to suppose were much more advanced in the arts than their blood relations, the Aztecs. An examination of the external contour of this instrument in the plate, Fig. 4 (Plate XIX), will show that the barrel or body of the flageolet is much narrower and more elongated than that of the pitch-pipe, Figs. 5–6, (Plate XVII). The interior construction shows an increased expansion underneath the sound-hole, Fig. 5 K (Plate XIX), and marked contraction at the bell end, Fig. 7 F (Plate XIX).




Ă.B̂. C̆.D̂.

Fig 5. 2 3 5 7 7 9 11 or 2 2 5 5 7 9 11.

Fig 6 1 3 8 8 . . . . or 1 3 8 8 (E. flat)

Fig 7 2 4 6 9 . . . or Scale of F (Natural)

Fig 8 3 5 7 7 . . . or Scale of D (2 sharps)

Fig 9 4 7 8 L. Double whistle*, Scale of A (4 flats)

Also other interesting Combinations, Viz. . . .

2 2 6 9. or F (1 flat) . . . 3 2 5 7. D (5 flats)

6 5 7. (Octave-missing) G (1 Sharp) or 6 6 8. L W (G 1 Sharp)

* L Double Whistle, see fig 4 (Plate 2.)

Ancient Mexican Musical Instruments.

whistle may be made to produce a variety of sounds by the addition of finger perforations. It also resembles them in its powers of producing different sounds, of a higher pitch, by blowing with unusual force."

As the manipulation of the ancient Mexican pitch-pipes of terra-cotta has never been fully described, some details upon the subject will be necessary. It has been mentioned in a former article that the clay pitch-pipes which stand in the scale of E flat, may be played singly or in quartette. The single manipulation was accomplished by the well-known soloist on the Baehm flute, Professor J. S. Coxe (who having arranged the pitch-pipes in a cardboard frame like a mouth organ), was enabled to play thereon numerous simple melodies. By this means results were obtained (by one performer) like those produced by four persons manipulating them alternately (holding one in each hand). A record has been kept of these manipulations by numbering the whistles from tonic to octave (1–8), and as a ninth, eleventh and twelfth exist (alto a double whistle) the numeration was extended to twelve. As it is necessary, in producing certain intervals and melodies, to close the stop-holes upon some instruments, leaving them open in others, the black dot placed alongside of the numbers or letters indicate closed stop-hole, and the naught open stop-hole. The different signs or modulations for the blowings, shown in Figs. A B C D (Plate XVIII) signify blow evenly (Fig. A sign thus ⌣ turned upward) and blow hard, (Fig. B ⌢ turned downwards).

Where it is necessary to blow very hard, double modulation signs are used (turned upward). In blowing soft, and vice versa, in blowing very hard (turned downward). By this means a method of procedure is obtained by which all confusion can be avoided, and the pipes played with facility. If the note of the large elongated pitch-pipe, Fig. 6 (Plate XVII), standing in A (three sharps), be taken as a tonic note, the intervals of two octaves[1] may be obtained by following the enumerations and stoppings given in Fig. 5 (Plate XVIII). The scale of E flat is given in Fig. 6 (Plate XVIII), also several other combinations of intervals in other scales, such as F

[1] A second method of fingering and stopping is given in Fig. 5 (Plate XVIII), by means of which the intervals of two octaves may be obtained. This fingering, however, owing to some imperfection in one of the pipes, does not produce the intervals clearly. Some of the whistles have been impaired by their long burial.

natural, Fig. 7 (Plate XVIII), D (two sharps), Fig. 8 (Plate XVIII), and finally the intervals of the scale of A (four flats), Fig. 9 (Plate XVIII).

That duplicates of these Aztec pipes of terra-cotta exist (in the Poinsett collection of Mexican antiquities) which are pitched in like keys, has been proven beyond a doubt, viz., three duplicates of the octave or No. 8 pipe (scale of E flat), two of No. 9, two of No. 5 pipes. It is certainly an interesting fact that in a collection of sixteen pitch-pipes, seven out of this number correspond with one another. *This sameness of pitch cannot therefore be attributed to an accidental similarity of musical sounds.*

Terra-cotta pitch-pipes, similar to those shown in Figs. 1 and 5 (Plate XVI), which were excavated in 1852 from an ancient tomb near Vera Cruz, by the late Professor Charles H. Budd, are pitched in like tones to Nos. 8 and 9 in the Poinsett collection.

The Indians of the present day, in various parts of Mexico, manufacture whistles of an inferior kind, which do not, however, in any way approach the ingenious clay-reed pipes of their ancestors, either in construction, tone or decoration, still there is an innate love for music among the descendants of the old Nahuatalac and Maya races, which has frequently been commented upon by travelers. Dr. Habel's learned article entitled "Archæological investigations in Central and South America," published by the Smithsonian Institution in their Contributions to Knowledge, page 45, speaking of the South American Indians, states that he found the pipe the only national instrument. It is of various dimensions, and almost every traveling Indian has one at hand, piping while he walks on the road or in the market.

Whistles fashioned like birds, animals and monsters of grotesque shape are quite numerous in the cemeteries of Mexico and Central America. They generally emit shrill sounds, which Mr. Barber, in his valuable article on "Indian Music," has compared to a peculiar noise like the escape of steam (AMERICAN NATURALIST of March, 1883). Others examined by the writer of this article give harsh sounds when blown into forcibly, not unlike the chatterings of macaws and parrots. They had been modeled in three pieces, viz., the mouth-tube, Fig. 10 T (Plate XVII) and Fig. 1 T (Plate XVIII). The body, which is most ingenious in construction, and bears an important part in the production of the sound emitted, is made in two parts

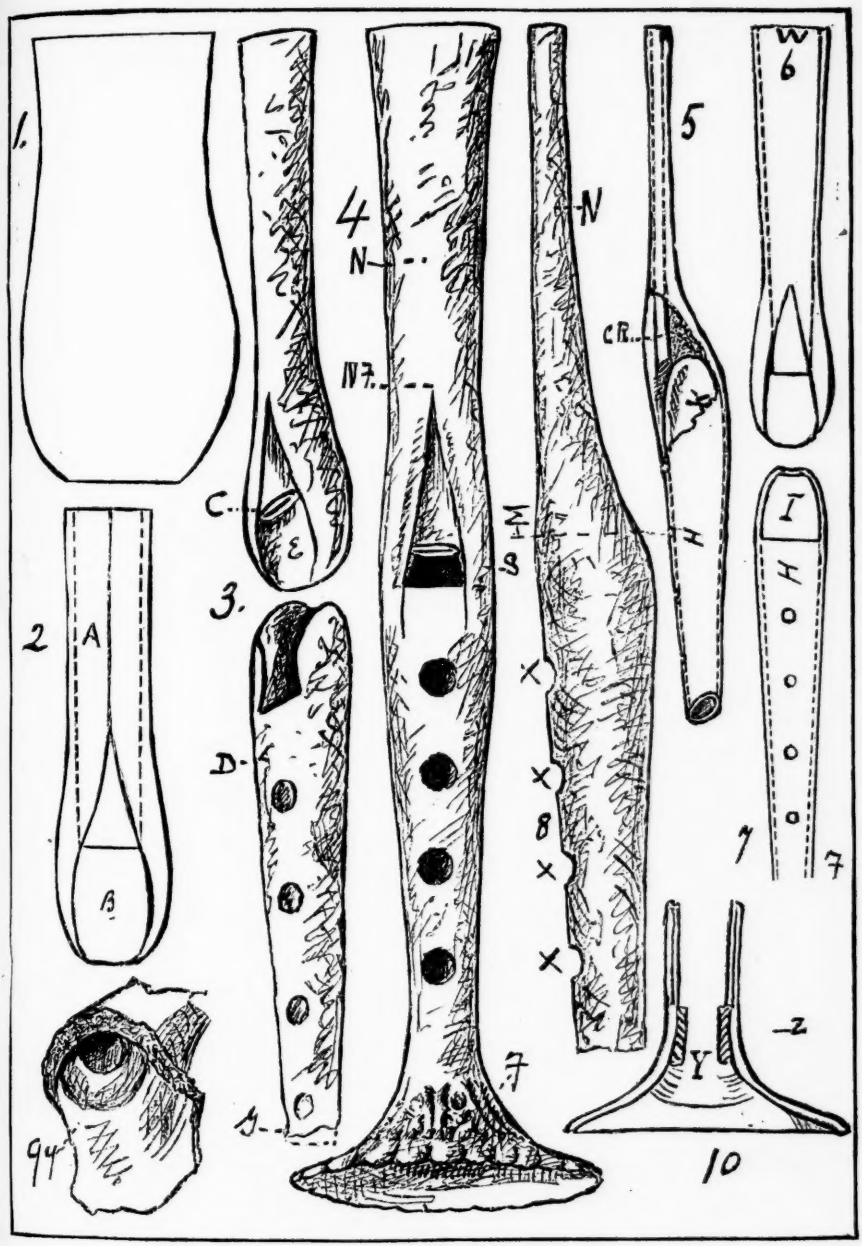
or pieces, viz., the body and cover, Fig. 10 U (Plate XVII) and Fig. 1 A (Plate XVIII). The grotesque whistle, Fig. 8 (Plate XVII), shows the jointure of its several parts, and for this reason it has been chosen for description. The mouth-tube, Figs. 10 T, 9 H (Plate XVII), is of simple construction, having been made upon a round form, narrowest at the end approaching the body portion, see Fig. 10 G (Plate XVII). This illustration has been drawn from an instrument in which the body cover, or top, has been removed. It will be seen that the mouth-tube is held in position by the clay flaps, on either side, opposite a small hole in the body of the whistle, thus directing the current of air into its hollow interior. The body was, without doubt, modeled upon a semi-ovate form, the perforated top being added after it was withdrawn. The position of the body varies in different whistles, but in most cases is tilted, with the flat top-piece (or cover of the semi-ovate body) forward and inward, thus placing the sound-hole exactly in front of the narrow end of the tubular mouth-piece, Fig. 10 G (Plate XVII), conducting the air within, and making the necessary vibration to produce sound. The body cover serves two purposes, that of uniting the body and mouth-tube firmly together, also that of reflecting sound outward, after its production in the semi-ovate cavity.

The four-holed Nahuatalac flageolet of terra-cotta, found near Tezcuco, Fig. 4 (Plate XIX), shows a superior knowledge in its construction, power and variety of sound to any other wind instrument of music manufactured by the North American aborigines excepting, of course, those manufactured by the Inca Peruvians. An examination of the various parts of the four-holed Tezcucan flageolets of terra-cotta will demonstrate that they have been made in four parts. viz., the clay reed, Fig. 2 A (Plate XIX), shown by the dotted lines; neck-covering, or flap, Fig. 1 (Plate XIX); the body, Fig. 3 D, and the bell, or foot, Fig. 4 F (Plate XIX). Sections of these instruments, Figs. 5, 6, 7 (Plate XIX), made in profile, indicate that they were modeled upon round elongated forms. That of the body portion is narrowest at the bell end, Fig. 7 F and 5 K. The shape of the form upon which the neck-piece was modeled, is shown by the dotted lines in Fig. 6, contracting at the sound-hole, and gradually expanding as it approaches the mouth end, Fig. 6 U. The finger-holes (four in number) have been perforated through the body Fig. 8, from the

outside while the clay was in a semi-dry condition. A hollow instrument seems to have been used for this purpose, leaving here and there small ragged edges of clay adhering to the interior of the barrel around the edge of the circular perforations. The bell, Fig. 4 F, is concave exteriorly, of circular form, and decorated with designs of unique patterns which have been stamped thereon by terra-cotta forms or dies. The internal portion of this bell is hollow, becoming convex as it approaches the edges, and contracting at the point of connection with the tube or barrel to a thickness of half an inch. Around this is formed a small cup-like cavity, Figs. 9 y, 10 y, which bears a most important part in manipulating the instrument. It can readily be seen, by an examination of the careful drawings shown in Figs. 9 y, 10 Y (Plate XIX), that these are not accidental formations, as has been suggested, but have been adapted to the form of the finger ends *to serve a particular purpose, viz., that of finger-stopping the bell.* The necks, Figs. 8 N, 4 N (Plate XIX), and clay reeds, Figs. 4 C, 2 A, 5 C R (Plate XIX), of these four-holed flageolets, have been modeled in the same manner as those upon the pitch-pipes, excepting that forms of greater length were required on account of the elongation of the mouth-piece.

The instrument shown in Fig. 4 (Plate XIX), viewed in front, is quite broad at the commencement of the mouth-piece, Fig. 4 (Plate XIX), contracting slightly as it approaches the division of the neck-flap, Fig. 4, N, F, and then expanding to its greatest thickness opposite the sound-hole, Fig. 4, S, where the neck-flap and body portion have been joined together (see section Fig. 5, Plate XIX). From the sound-hole it gradually contracts until the place of junction with the bell is reached, Fig. 3, G, from thence gradually increasing in size until near its lower portion (*i. e.* the bell proper), when the expansion and curvature is quite rapid, forming, at last, a flat plane upon its outer edge. Viewed in profile, Fig. 8, N, the neck is quite delicate, and like the reed in shape, Fig. 5, C, R (Plate XIX), gradually growing larger as the middle of the body, Fig. 8, M (Plate XIX) is reached. A gradual curve from above downwards here unites the mouth-piece with the body, which tapers gradually from this point until its junction with the bell, Fig. 4 F (Plate XIX), thus forming an instrument of graceful contour and artistic construction.

The instruments in the Poinsett collection of antiquities differ

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somewhat in the color of the glazes by which they are covered. The flageolet shown in the illustration, Fig. 4 (which was found with several others at Tezcuco, in Mexico), is covered with a light-red glaze. In the B flat instrument the glaze is a dark-brown color, and in other fragments of pipes, of like kind and construction, it is a heavy, vitreous glaze of a dark vermilion color, resembling that which covers the tips of the mouth-piece in the pitch-pipes. This glaze, in most cases, when the instrument is of a light color, is covered by one or two bands of a darker hue, generally placed as ornamentations between the first and second finger-holes, thus adding to the variety of the color, which would otherwise be monotonous. It is worthy of remark that ornamental bands of paint *overlie* the original glaze in some cases, and in others, as in the B flat instrument, they *underlie and are covered by it.*

Having considered the construction of the ancient Mexican pitch-pipes and four-holed flageolets of terra-cotta in all their parts, externally and internally, the student of aboriginal American plastic art cannot fail to be impressed with the ingenious construction, artistic feeling and inventive power displayed by the barbarian people who fashioned them. *This, it has been shown, was accomplished by modeling their terra-cottas upon forms* (in pieces), probably made of polished bone or wood. The pieces or sections produced upon the forms in question, were joined together while in a semi-dry or green state, by means of liquid or soft clay (which method is still used by our modern potters), thus enabling the ancient Mexican clay-workers to finish their musical instruments in parts. *The use of piece-forms* seems to have been quite common among the Nahuatalacs and the ancient clay-workers of Nicaragua,[1] Costa Rica and Peru in manufacturing

[1] The ancient pottery manufactured by those people who once occupied that portion of Central America now called Nicaragua, suggests, by its superiority of execution and glaze, that the potter's art here attained a higher degree of excellence than among the Aztecs, and in many respects, such as delicacy of form and finish, is equal to that of the Inca Peruvians. A good example of this is shown by a tripod vase, Figs. 3 and 4 (Plate XVIII), brought from Nicaragua by the late F. G. Smith, Esq., in 1859. It was found on the Island of Ometepec, in the Lake of Nicaragua, in a perfect condition, and during its transportation to the United States it was broken through the middle, thus revealing its interior construction. It will be seen by an examination of the careful drawing (showing a section thereof) that the body portion and legs were hollow and filled by small clay balls. It is the opinion of those skilled in the potter's art that this unique tripod vase could not have been made ex-

*certain kinds* and portions of their intricate terra-cotta fictile wares.

In conclusion, it is also worthy of remark that a knowledge of the process of modeling in clay upon forms seems to have been known to most all of the savage and barbarian nations of America who were acquainted with the art of pottery, and more especially to those of our American aborigines, who occupied the middle status of barbarism. Many of the beautiful earthenwares from the mounds of Louisiana, Missouri and those parts of our Western States at one time occupied by the mound-builders suggest the use of forms or shapes. Specimens of ancient water bottles from British Guiana and the (long-necked) bottle-shape jars and vases from the mounds of Indiana, Tennessee and Missouri in the William S. Vaux and Haldemann collections, prove the truth of these assertions.

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## EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— *E pur se muove.* The Philadelphia Academy has added two professors to its corps, and, it is said, will soon add a third. As the gentlemen selected are all capable, original investigators, important progress has thus been made. In fact, the organization adopted eight years ago may now be said to have the active support of the members of the academy.

The institution having at length acquired a center of vitality, new questions arise. Having escaped the Scylla of paralysis, it must avoid the Charybdis of being pressed into service which does

cept upon piece forms, and that the pieces modeled thereon were united during the semi-dry or green state. The clay balls in the interior of the legs and body portion are the best proof of this assertion, as they must have been placed therein during the jointure of the vase, before the firing process (see Fig. 4, Plate XVIII, where a section of this vase is given, showing the position of the clay balls between the plates of earthenware that form the body). It will be seen that these two concave disks are united together and so fashioned as to leave a space within, into which the pellets of clay were placed. There is no connection between the body part and legs except by delicate perforations about the size of a pin's head, leading from the body into the legs. The legs, in their turn, are perforated by small holes of a like kind, thus allowing the heated vapors to escape during the firing. The theory advanced by certain writers that the clay balls in the interiors of the Mexican Jacaxtli (and other hollow terra-cottas) were detached by a sharp cutting tool, after the firing, is an absurdity which no careful student of aboriginal American plastic art will credit.

not belong to it. Some of its members desire to make it a school for teaching science to the young, a function which does not belong to an academy of sciences, but to a university or other school. That the primary object of the academy has always been original research, is well known; and that it is the desire of most of the scientific specialists connected with it that it should be devoted to that purpose, is undoubted. Instruction to post-graduates might be given in connection with its laboratories of research, but not to such an extent as to interfere with the main object.

The inaugural address of Professor Sharp was a clear exposition of the methods employed in some of the continental laboratories, and furnished an outline for work to be done in his own department, invertebrate zoölogy, in the academy.

One reason for introducing this institution so frequently to the notice of our readers is, that it is representative of the average local American "Academy of Sciences." If these institutions are ever to resemble their prototypes of the old world, it will have to be by a process of growth something like that which the oldest academy in the country is undergoing. They will have to pass from the club stage to the working stage, and self-preservation will require a third more or less exclusive stage. The obstacles to be overcome will be very similar everywhere.

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## RECENT LITERATURE.

DUTTON'S TERTIARY HISTORY OF THE GRAND CANON DISTRICT.[1] —This elaborate monograph on perhaps the most imposing gorge in the world, has been thoroughly well done and superbly illustrated. The author gives a rapid summary in the twelfth chapter of the changes which have taken place and have produced the present wonderful scenic features of this region. Before the Carboniferous period thick beds of Silurian and thinner deposits of Devonian sediments were laid down, though a guess whence they were derived is not hazarded. The region was then upheaved, enormously eroded and again submerged. Upon the eroded surface the Carboniferous rocks were unconformably deposited, and the deposition of sediment was continued until the end of the Mesozoic, resulting in the accumulation of from 12,000 to 16,000 feet of strata over the entire Plateau province. The Carboniferous deposits may have accumulated in an ocean of

[1] *United States Geological Survey.* J. W. POWELL, director. Tertiary History of the Grand Cañon district, with atlas. By Captain CLARENCE E. DUTTON, U. S. A. Washington, Government Printing Office, 1882. 4to, pp. 264.

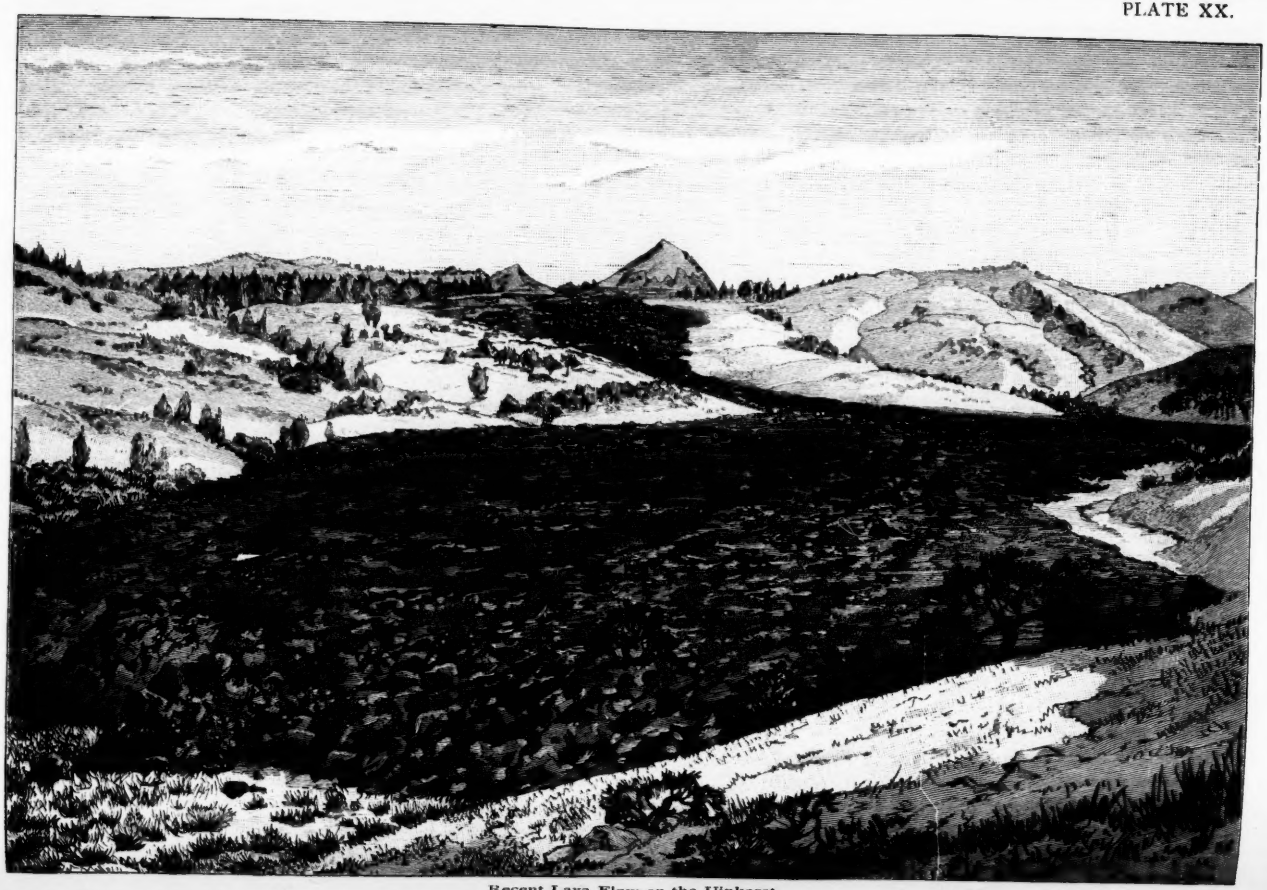
moderate depth, but the Mesozoic beds were all shallow-water deposits, and they sank as rapidly as they accumulated.

"Near the close of the Cretaceous, signs of the coming revolution make their appearance. The waters became brackish, indicating a restricted access of the ocean. At the close of the Cretaceous important disturbances took place, and portions of the province were uplifted and denuded. These were again submerged, but the new conditions differed from the old, for the new deposits (Eocene) laid down unconformably upon the Cretaceous and Jurassic are of fresh-water origin, indicating that a great lake was formed. The extent of this lake corresponds very nearly with that of the Southern Plateau province itself, but not exactly. Near the Middle Eocene began that slow action which has gradually elevated the western portion of the continent, and which has prevailed until a recent epoch."

During the Tertiary, erosion went on continuously, the thickness removed from some large areas amounting to about 10,000 feet, and much the greater part of this denudation was probably accomplished by the close of the Miocene.

"The Colorado river appears to have originated in very early Tertiary time as the outlet of the great Eocene lake, and has persisted in its course ever since. It has been the main track along which the waste of the province has been carried to the Pacific. At its beginning its bed lay in Eocene strata, and as the land rose it cut down its channel by corrasion, severing in succession all the beds of the Mesozoic and Carboniferous systems. That portion of it which constitutes the Grand and Marble cañons has cut through 10,000 to 16,000 feet of beds, reaching a maximum amount in Kaibab. The present Grand cañon represents only the corrasion through the Carboniferous and into the Archæan. The older corrasion of superior beds becomes manifest only when we restore, in imagination, the Mesozoic strata which have been denuded from the vicinity of the chasm. The present Grand cañon, therefore, is the work of late Tertiary and Quaternary time. Although we cannot fix with precision the exact epoch at which the river first penetrated the Carboniferous beds, we may, in roughly approximate language, place that epoch near the beginning of the Pliocene or close of the Miocene."

Among the more interesting points elucidated besides the gorges of the Colorado, are the basaltic eruptions of older and some of very recent date. After describing the ancient basalts of Mt. Trumbull and other masses, which are much eroded, attention is then drawn to the fields of recent basalt, which look "as fresh as any *coulée* of Vesuvius ejected twenty or thirty years ago." Plate XX represents one of these fields. Compared with the other later eruptions of the Uinkaret, its dimensions are larger than the average. It entire surface is covered with blocks of pumice of the most delicate kind. It has a texture very much



Recent Lava Flow on the Ulinkaret.

like the lightest coke, the vesicles, however, being considerably larger than those of the ordinary coke, and very uniform throughout. The septa between the vesicles are very thin, and the whole mass is so light that when a specimen is varnished over to prevent access of water to the cavities, it floats upon water like a cork. * * * Any attempt, however, to fix the age of these lavas must prove quite fruitless. All that we can say is, that it is very recent, even when time is judged by the historic or human standard. It cannot be many centuries old, and it may be more recent than the Spanish conquest. But there are reasons why lavas should here preserve for centuries the freshness which is lost in other countries in as many decades. The climate is arid, and there can be no question that the chemical action of the meteoric agents upon the lavas proceeds here with extreme slowness.

The volume ends with a discussion of the mode of excavation of the Grand cañon, of corrasion and weathering, and finally with a treatment of the details of its erosion.

Not only for its full and well written account of the geology of an extensive as well as not very accessible region, will the volume have its use, but especially as a contribution to dynamical geology, with regard chiefly to the action of running water and weathering, will this volume possess permanent value.

It is hardly necessary to add that the pencil of Mr. Holmes, whose genus for sketching geological panoramas is almost unique, has added materially to the value of the work. The wood-cuts and photo-engravings are drawn in his superior manner, while the chromo plates evince his facility in the use of water-colors.

Capt. Dutton's style and mode of handling his subject is clear and elaborate, and worthy of the subject. The atlas is in Bien's best manner.

GARMAN'S NORTH AMERICAN REPTILES AND BATRACHIANS.[1] —The first-named of these brochures, as a simple catalogue is by itself of little weight as a contribution to science, but as connected with the illustrated paper which bears the second of the titles given below, and as a possible prodromus of others, it deserves attention. The system of the Bulletin No. 1 of the National Museum (which is devoted to this subject) has been so generally adopted by American herpetologists that it becomes necessary that some good reasons should be adduced for the many differences from it which the present system and list present. These reasons have not been given, so far as we are aware, and we think it can be shown that none can be found.

The author of these papers has clearly not been equipped for the task he has undertaken. In the systematic department he

[1] *A list of the species occurring north of the Isthmus of Tehuantepec, with references.* From the Bulletin of the Essex Institute, Salem, Jan., 1884. On the Reptiles and Batrachians [of the Kentucky Geological Survey]. From the memoirs of the Museum of Comparative Zoölogy, Cambridge, Mass. 4to (no date).

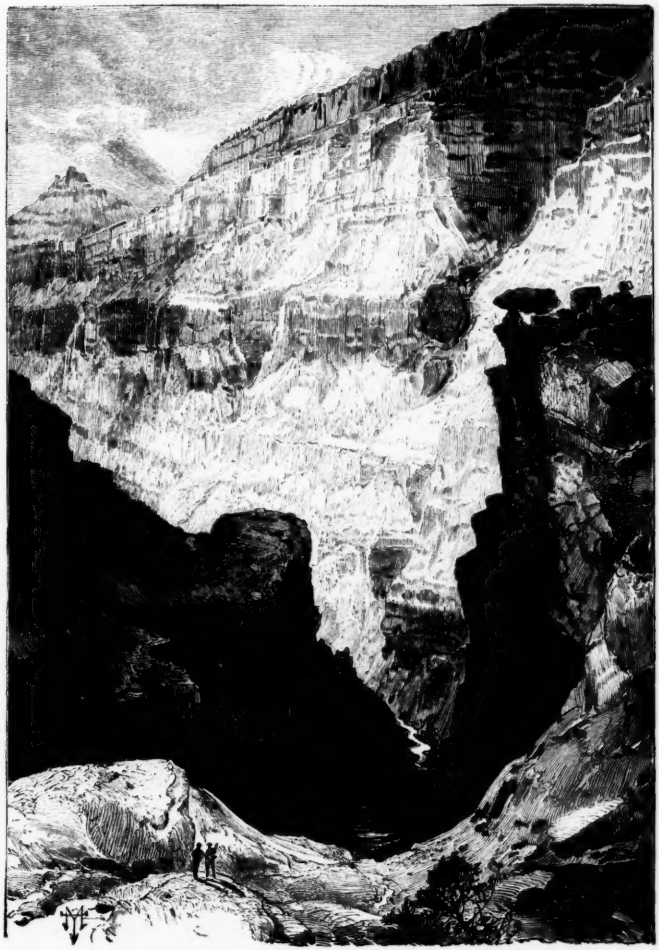
creates a number of new names, including two new generic names, which is an inexcusable proceeding, because the names are unnecessary. His selection of genera for adoption is purely arbitrary. Most of the rejected stand on as valid basis as those adopted, some of them on identical characters, as, for instance, Eutænia rejected and Ophibolus adopted, both resting on the entire anal scutum. The adoption of specific names is equally arbitrary. Of both kinds of types the author not infrequently displays remarkable ignorance. Thus the genus Hypsiglena Cope, is adopted, but a species of that genus, *H. torquatus*, is placed in Sibon, and two distinct species of the latter genus are placed under the "*S. torquatum*" as varieties or sub-species. So with *Sympholis lippiens* Cope, which appears in one place as a species of "Gophis," and in another under the synonym *Chilorhina villarsi* Jan., as a distinct generic form. *Contia episcopa* appears under the sub-generic head Contia, while its variety, *C. isosona*, is placed under the sub-generic head of Sonora. The *C. pygæa* is not in the list at all. There are, in fact, several omissions of North American species, and so many Mexican species are omitted that the title of the paper is misleading. The arrangement of the species within the genera is confused, and does not in any way express their mutual relations. As an instance we refer to the collection of species he calls Geotriton. Four species of Spelerpes head the list, then an Œdipus (*O. variegatus*), then a Spelerpes, then an Œdipina, then four Spelerpes, then two Œdipus; then follows a Stereochilus, then a Eryinophilus, then a Spelerpes, and finally an Œdipus identical with the fifth on the list above named. No species of Geotriton appears. When we compare this suppression of genera with those adopted among the tortoises, at least nine of which are worthless, the inconsistency is striking.

The author of the catalogue has a singular plan of applying to a species the name of the author of the paper or work in which the description first appeared, although it may have been composed and written by another person whose name has been given as that of the true author. Thus Dr. Deyis has the pleasure of learning that the *Adelophis copei* was described by Cope and not by himself. All the species described by Cope in the Zoölogy of the Wheeler Survey are attributed to Yarrow, the zoölogist of the expedition; those published by Cope from Baird's manuscript are attributed to Cope, but with the complimentary insertion of a "Bd." in parentheses.

To correct this list would be to rewrite much of it. We only add that the *Diploglossus millepunctatus* O'Sh., is what Mr. O'Shaughnessy took it to be, and is not a Eumeces, as supposed by Mr. Garman; and that the list of species of Ophibolus is a miracle of confusion.

As with the genera, the adoption of species and subspecies is entirely arbitrary, and appears to depend on nothing but the fancy

PLATE XXI.



A lateral Amphitheater of the second order in the Grand Cañon.

of the author. An example of this may be seen in his species of Crotalis. Besides ignoring some good species, he adopts the *C. polystictus* under the later name, *C. ximmesii*, while he places the name *C. polystictus* as a synonym of the different *C. triseriatus* of Wagler. The quarto volume referred to contains a number of good plates, which gives some value to the work. On the whole, however, we think the author should have waited until his knowledge of the subject was more complete before attempting to publish.

GALTON'S RECORD OF FAMILY FACULTIES.[1]—This book is a series of blanks designed for those who may desire to forecast the mental and bodily faculties of their children, and to further the science of heredity. As stated in the preface, the natural gifts of each individual being inherited from the ancestry, it is possible to foresee much of the latent capacities of a child in mind and body, of the probabilities of his future health and longevity, and of his tendencies to special forms of disease, by a knowledge of the traits of his ancestors. When the science of heredity shall have become more advanced, the accuracy of such predictions will improve, and meanwhile we may feel assured that fewer blunders will be made in rearing and educating children, under the guidance of a knowledge of their family antecedents, than without it.

It is to be hoped that those at all interested in the improvement of the race in general, as well as their own descendants, will make a fair trial by keeping such a record as this, and we hope that similar blanks may be issued in this country by our boards of health, a work which has already, we believe, been done in Massachusetts.

In reading the introduction, and looking over the blanks, we may obtain some idea of what of a practical nature is involved in the idea of heredity. It is the custom with many to make light of heredity, as if there were little in the matter; whereas, the intelligent observer is well aware that, together with variation, heredity is one of the twin forces in the world of life.

One is proud of his distinguished ancestors, but in such a record as this, equal attention is paid to the claims of every ancestor in the same degree of kinship. "No countenance is given to the vanity that prompts most family historians to trace their pedigree to some notable ancestor, and to pass the rest over in silence. It demands an equal recognition of all the lines. We should remember the insignificance of any single ancestor in a remote degree. In the fourth generation backwards there are sixteen ancestors, from whom the child receives on the average an equal inheritance. In the fifth there are thirty-two. One ancestor who lived at the time of the Norman conquest, twenty-four

[1] *Record of Family Faculties*, consisting of tabular forms and directions for entering data, with an explanatory preface. By FRANCIS GALTON, F.R.S. London, Macmillan & Co., 1884, 4to.

generations back, contributes (on the supposition of no intermarriage of kinsfolk) less than one part in 16,000,000 to the constitution of a man of the present day."

Mr. Galton thinks that if the father of a family of children collects all the required data concerning his own parents and grandparents, and similarly those concerning the parents and grandparents of his wife, then it is probable in most cases that their children, being informed about all their ancestry up to their eight great-grandparents inclusive, will be equipped with almost as much hereditary information as they can need.

Thus far our ignorance, the author claims, of the conditions by which the level of humanity may be raised, is so great that he believes "if one had some dictator of the Spartan type, who exercised absolute power over marriages, assigning A to be the wife of B, and C to be the wife of D, and who acted with the best intentions, he might possibly do even more harm than good to the race." No man is isolated from his fellows, but is "a prolongation of his ancestry in no metaphorical sense," and the author claims that the compilation of these registers will extend this conviction very widely. In order to obtain statistics bearing on heredity, Mr. Galton offers £500 in prizes to those British subjects resident in Great Britain who shall furnish him with the best extracts from their own family records.

BALBIANI'S LECTURES ON THE SPOROZOA.[1]—The class of Sporozoa was founded by Leuckart in 1879, by whom it was regarded as a new group of Protozoa. Besides the Gregarines it embraced all those parasitic unicellular organisms called Psorosperms. Besides the oviform Psorosperms or Coccidia of Leuckart, in 1881 Bütschli proposed the name of Myxosporidia for the Psorosperms of fishes. In 1882, in his lectures, Professor Balbiani suggested the term Sarcosporidia for the utriculiform Psorosperms, while he places among the Sporozoa a fifth group, which he designates as Microsporidia, comprising the vibrating corpuscles of the silkworm and allied organisms, regarded for a long time as Psorosperms by Leydig and himself.

As thus constituted we have, for the first time, in this useful work a succinct and interesting account of these strange parasites, which are so widespread throughout the tissues of all animals, from the Infusoria to man, and which correspond to the Bacteria among the Protophytes. One of them causes fatal sickness by its rapid and extreme multiplication in the liver of the hare, and has also once occurred in man, producing death. Several of them propagate epidemically, and give rise to more or less fatal epizootics; such are the Sarcosporidia of the sheep and poultry, which

[1] *Cours d'Embryogenie comparée du College de France. Lecons sur les Sporozoaires.* Par G. BALBIANI. Recueilles par le Dr. PELLETAN. Revues par le Professeur. Avec 52 figures intercalées dans le Texte et 5 Planches lithographiées hors texte. Paris, 1884. 8vo, pp. 184.

sometimes decimate the sheep-folds and poultry yards. A great number of fresh-water fishes die owing to the development of Myxosporidia in their tissues, a cause of destruction of these animals in our fish ponds which is still generally ignored. Finally, says the author in the preface, the epidemic invasion of the Microsporidia in silk-raising establishments gave rise to the disease called *pebrine*, which for twenty years has nearly ruined the silk industry throughout the world, and cost France alone more than a millard francs.

Professor Balbiani adds that while MM. Aimé, Schneider and Bütschli have recently enriched the history of the Gregarines and Coccidia, his own contributions relate chiefly to the Myxosporidia and Microsporidia.

After describing the Sarcosporidia, or tubular Sporozoa, he discusses their systematic position, acknowledging the difficulty of correctly classifying them, but following Leuckart in regarding them as animal rather than vegetable. These organisms live as tubular masses of ovoid organisms buried in the muscle of the pig, Otaria, etc., and Balbiani believes that they begin by living on the surface of their host.

The Myxosporidia, or Sporozoa of fish, are treated in an interesting way, with a number of original sketches.

In the chapters on the Psorosperms of articulates (Microsporidia) we have an interesting historical sketch of the discovery of these parasites, which were first detected in 1853, by Leydig in *Coccus hesperidum*, and afterwards in spiders, a bee, a crane-fly and in Daphnia. These he regarded as vegetables, but as belonging with the Psorosperms. Here belongs the organism which causes pebrine, and which Pasteur regards as *organites*, but neither animal or vegetable. This view Balbiani combats with considerable feeling and at considerable length, fortifying his position with sketches, maintaining that they are animal and belong with the Sporozoa.

Report of the Geological and Natural History Survey of Canada for 1880–'81–'82.—We have but just received this report, which bears date of 1883. With it comes a catalogue of Canadian plants, Part I, Polypetalæ, by John Macoun, forming a volume of 192 pages, and containing interesting notes on the occurrence and distribution of the species. We should have expected to find more detailed notes on the Labrador species than we do.

The geological report itself being for a period extending through three years, cannot here well be analyzed. Dr. G. M. Dawson makes a preliminary report on the geology of the Bow and Belly River region, Northwest Terr., with special reference to the coal deposits; Dr. R. Bell reports on the geology of the basin of Moose river and adjacent country, and on the geology of the Lake of the Woods and region adjoining. The most elaborate

reports are those of Mr. R. W. Ells on Northern and Eastern New Brunswick and the north side of the Bay of Chaleurs, as well as the Gaspé peninsula, illustrated by several folding maps. Artotypes and lithographic plates illustrate the scenery.

Besides his introductory reports the director of the survey, Dr. A. R. C. Selwyn, furnishes a chapter entitled: "Geological nomenclature and the coloring and notation of geological maps," which will attract attention.

RECENT BOOKS AND PAMPHLETS.

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*Riley, C. V., Packard, A. S., Thomas, C.*—Third report of the United States Entomological Commission. Washington, 1883. From the commission.

*Chapman, H. C.*—History of the discovery of the circulation of the blood. Phila., Blakiston & Co., 1884. From the author.

*Gill, Th.*—The principles of zoögeography. A presidential address delivered at the Biological Soc. of Washington, Jan. 19, 1883. From the author.

*Dollo, M. L.*—Premiére note sur les Crocodiliens de Bernissart. Ext. du Bull. du Mus. Roy. d'Hist. Nat. de Belg., 1883. From the author.

——Note sur la presénce du *Gastornis edwardsii* Lemoine, dans l'assise inférieure de l'étage Landenien a Mesvin, près Mons. Ext. idem. From the author.

*Curtis, J. S.*—Abstract of report on the silver-lead deposits of Eureka, Nevada. Ext. Ann. Rep. Director U. S. Geol. Surv. From the author.

*Hyatt, A.*—Genera of fossil Cephalopods. Ext. Proc. Bost. Soc. Nat. Hist., 1883. From the author.

*Whitehouse, Cope.*—The myth of Fingal's cave. From the author.

*Clevenger, S. V.*—Clinical and pathological reports of cases of insanity. Rep. from the Chicago Med. Jour. and Exam., 1884.

——Paretic dementia in females, with report of a case. Rep. from the Alienist and Neurologist, 1884. Both from the author.

*Campbell, J. L., and Ruffner, W. H.*—A physical survey in Georgia, Alabama and Mississippi, along the line of the Georgia Pacific Railway. New York, E. F. Weeks, 1883. From W. H. Ruffner.

*Christy, R. M.*—On the methodic habits of insects visiting flowers. Ext. Linn. Soc. Jour., 1883. From the author.

*Randolph, N. A.*—A study of the distribution of gluten within the wheat grain. Ext. Proc. Nat. Sci. Phil., 1883.

——A note on the fæces of starch-fed insects. Ext. Trans. College Physicians of Phila., 1883. Both from the author.

*Roussel, A. E., and Randolph, N. A.*—An examination of the fæces of twenty persons receiving inunctions of cod-liver oil. From the authors.

*Williston, S. W.*—On the North American Asilidæ, with a new genus of Syrphidæ. Ext. Trans. Amer. Ent. Soc., 1883. From the author.

*Wilder, B. G.*—Cartwright lectures on methods of studying the brain. Lecture No. I. Ext. N. Y. Med. Jour., Feb. 9, 1884. From the author.

*Sewall, H.*—Experiments upon the ears of fishes with reference to the function of equilibrium. Ext. Jour. of Physiology, 1883. From the author.

*Ryder, J. A.*—Rearing oysters from artificially-fertilized eggs, together with notes on pond culture, etc. Ext. Bull. Fish Commission, Vol. III, 1883. From the author.

*Worthen, W. A., St. John, O., Miller, S. A.*—Geological survey of Illinois. Vol. VII. Geology and palæontology. Boston, 1883. From the authors.

*Dobson, G. E.*—A monograph of the Insectivora, systematic and anatomical. Part I and II. London, J. Van Voorst, 1883. From the author.

## GENERAL NOTES.

### GEOGRAPHY AND TRAVELS.[1]

ASIA.—*Perak and its Tin.*—The little state of Perak, upon the western shore of the peninsula of Malacca, is in a fair way to become the world's principal center of tin production. Perak occupies a district about ninety miles long by fifty wide, and is traversed by three chains of mountains parallel to the sea. These mountains are separated by plains, the chief of which is traversed by the Soungi Perak, or river of silver, a fine stream some 150 miles long, and navigable for Malay barks throughout most of its length. European ships of more than 500 or 600 tons cannot ascend beyond Dourian Sebatang, at which point the river turns westward toward the sea.

The temperature is equable, rarely exceeding 95°, or sinking below 76°; the alternation from the wet season (September to February) to the dry producing no change upon the temperature.

The mountain masses of Perak are granitoid. Sedimentary rocks occur only in patches, but almost the entire surface of the plains is covered with drift. The tin occurs in quartz veins in the granitoid rocks, and is in the form of the oxide known to mineralogists as cassiterite. The encasing rock of these veins, as is the case in Cornwall, is a porphyroid granite, with large crystals of feldspar.

*The Island of Hainan.*—This large island is not salubrious. Much of the soil on the coast is marshy, and fever rages both in the marshes and in the woods. The water contains much vegetable and mineral impurity; typhoons destroy the harvest before it is ripe, and Cantonese pirates make frequent descents upon the coast, and seize the trading-junks of the merchants. The natives are to all appearance like other Chinese, but are held in contempt and abhorrence by even the poorest boatmen of Canton.

The port of Hoi-how, with about 12,000 inhabitants, has really no harbor, but is exposed to typhoons and to the north wind. It is upon a river, and ships cannot approach within two miles of it. Some three miles distant is Kiungchow, the capital of the island.

On the main land opposite is the flourishing port of Pakhôi, the center of a large legitimate and larger contraband trade. Its harbor is an excellent one, extensive, deep, and well protected from storms.—(*Ch. Labarthe, Rev. de Geog., Janv., 1884.*)

*The Savages of Indo-China.*—Dr. Neis (Bull. de la Soc. de la Geog., 1883) recounts his adventures among the various tribes of Mois, who inhabit the country to the north and east of French Cochin China and west of Anam. The Traos, Stieng, Shop, Late, and Thioma are tribes of Mois, among which the Late seem to be the most defenceless. They have no fire-arms, and

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

when the Stiengs pursue them to procure slaves for the Laotians their only defence, except flight, is to plant sharpened bamboos in the paths. Our traveler also visited the remains of the Tsiampa, whose language resembles that of the Malays.

*The New Hebrides.*—M. Roberjot (Bull. de la Soc. de Geog., Paris, 1883), describes these islands, commencing with Annatom, the most southern. In the islands generally the males greatly exceed the females in number. In Annatom the latter are but six per cent of the population of 1215. Tanna has 4000 natives; the women wear a skirt of bark and cocoa-palm leaves, the men less still. The island is an active volcano. Erromango is entirely madreporic, and is the greatest source of sandal-wood. Sandwich island is also of coral. Near the village are seventeen hollow trunks of trees pierced with holes and a long slot on one side. By striking these a rude music is produced. In Mallicolo two upper incisors are struck violently out from all females of the age of puberty. Wooden tom-toms exist, with carved faces. The inhabitants are about 6000. Ambrym is a volcano, 1067 meters in height.

Spiritu Santo is the largest island, and is bordered to the south by a chain of coral islands. Two rivers flow into the canal between these islets and the main island. In this island the men assist in carrying burdens, which is not the case in the other islands.

AFRICA.—*South Central Africa.*—Mr. Anderson has recently transmitted to the Royal Geographical Society extensive notes and a map of the region between the Orange and Vaal rivers and the Zambesi, from ocean to ocean. The chief sources of the Vaal are in a district called New Scotland, where there are numerous small lakes, among them Lake Cressie, at an elevation of 5813 feet. The central part of the Káláhárá desert is traversed by the Omaramba, Black and White Nosop, Oup, and Elephant's river, all flowing southward into the Molapo, which runs westward at a little north of 26° S. lat., finally turning southward and entering Orange river under the name of Hygap. The Káláhárá desert extends northward to the Chobe as far as its junction with the Zambesi, from which point its eastern boundary runs nearly south to the Molapo, which it crosses further to the west, and extends to Orange river near Kheis. The Chobe rises much farther north than was supposed, as does also the Cubango, which, with the Okayanka Laagte, form the Tonka, flowing into Lake Ngami. Most of these rivers consist, during most of the year, of stretches of water alternating with dry beds. The Zouga flows between Lake Ngami and the great Makarakara Salt Vlei, and it is so level that in April and May it flows eastward; in June and July, westward. From the Zouga, near its exit from Lake Ngami, the Matabe runs to the Zambesi. This Matabe is the only outlet for

the waters of the Zouga and of the lakes; but occasionally, when there is no overflow, it runs southward.

Between the Hygap and Great Fish rivers, at about 27° S. lat., flows the Back river, with two outlets. The Great Fish river rises in S. lat. 22° 40′, flows south, and enters Orange river about ninety miles from its mouth. West of this river is a mountain country of granite, gneiss and trap, drained by numerous tributaries of the Great Fish river. The coast west of these mountains is a sandy desert, extending seventy miles inland. The upper courses of the Swakop, Kuisip and Omaruru are in a fertile country, among granite mountains, some of which attain an attitude of about 9000 feet, but the lower courses of these rivers pass through desert. Most of Ovampo-land, between the Cunene and the Káláhárá desert, is a high table-land, and is very healthy. The Káláhárá desert scarcely seems to be a desert in the usual sense of the word, but to be almost wholly a level, swampy region, with much jungle and many salt-pans. The rivers and salt-pans are, to a great extent, dry during much of the year, and the region is very unhealthy. Bushmen are the principal inhabitants. The eastern part of the belt surveyed, north of the Orange river, is drained by the Limpopo or Crocodile river, the sources of which are on the northern slope of the great water-shed that runs across the Transvaal south of Pretoria. The small lake from which flows the Marico affluent of the Limpopo is only ten miles distant from the eye or lake-source of the Molapo. The region around the Marico and the Notuane, an affluent of the Limpopo from the west, is described as healthy and well-wooded, with lovely mountains and park-like valleys. Other important tributaries entering the Limpopo from the Matabele country to the north of it, are the Makalapsie, Maclutsie, Shasha and Nuanettie, all flowing through a mountainous land, and having many branches. The water-shed of the Molopo mountains, averaging about 4300 feet in height, divides the affluents of the Limpopo from the Gwaii, with its tributaries the Kagane, Amatza, etc., and from the Umnyaki, all of which flow into the Zambesi. The country east of the Sabia, which, rising in the Molopo mountains, flows eastward to the Indian ocean, is ruled by the Zulu chief Umzila, and has not been thoroughly explored.

America. — According to Mr. Im Thurn, whose travels in British Guiana have recently been published, there is in the far west of that country, or over the Brazilian boundary, where the savannah itself rises 5000 feet above the sea, a flat table-land, the edges of which are more or less perpendicular cliffs 2000 feet high. No traveler has ever been round it, so that it may be accessible from the other side, and there is a way, as yet untried, which Mr. Im Thurn believes may prove practicable. The summit of this plateau of Roraima seems to be forest-covered, and enough is known of the fauna and flora of the district to make it

certain that a naturalist would find himself well rewarded for the ascent. There are traditions of strange isolated tribes that live in this inaccessible region.

Professor Geo. Davidson has communicated to *Science* the following particulars of recent volcanic action in Alaska:

The explosion of October 6, 1883, split perpendicularly in twain the mountain of St. Augustin, situated on the island of the same name, forty-nine miles west of the settlement on Port Graham or English harbor, in Cook's inlet, Alaska. Vast columns of smoke were seen to rise from the summit of the mountain, a column of white vapor rose from the sea near the island, and a great earthquake wave, twenty-five to thirty feet high, came upon Port Graham, followed by two other waves, estimated at eighteen and fifteen feet. Had it not been low water all the people of the settlement would have been lost. The tides rise and fall about fourteen feet. Capt. Sands, who was at English harbor, states that if there were plenty of water in the line of rupture of the mountain, it would be possible for a vessel to sail through. Capt. Culkie, of the schooner *Kodiak*, who approached St. Augustin on Nov. 10th, found a new island about a mile and a-half long and seventy-five feet high, that had been upheaved in the ten-fathom passage between the island and the mainland. At the same time two extinct volcanoes on the Alaskan peninsula, reported to be about west from the active volcano Iliamna (12,000 feet high), burst into activity. A party of Aleuts, living on the island, are supposed to be lost.

The Arctic.—*Novaya Zemlya.*—M. Grinevetsky, who journeyed across Novaya Zemlya in the spring of 1878, reports that the southern island consists of three different parts. The northern part is covered by mountains that are quite unknown, and is bounded to the south by the Pakhovaya river; the middle part is covered, on the west coast, by five or six parallel chains of hills, the highest summits of which reach 800 feet, while to the east is a wide plateau; and the southern part is a plateau not more than 450 feet high. There are two varieties of reindeer on the islands, one confined to the southern, the other to the northern island, and the latter variety greatly resembles the reindeer of Spitzbergen. This fact, taken with the feebleness of the cold sea current in Barentz sea, and the large amount of mud and gravel on the floating ice north-west of Novaya Zemlya, gives rise to the idea that Spitzbergen is connected with Novaya Zemlya by an archipelago.

The Archipelago of Cape Horn.—The French expedition has been actively engaged in surveying the coasts of this group of islands, which extend south of Beagle strait about 58° S. lat. These islands present the same structure as the continent of which they are the continuation. Off their western coast is an

almost continuous chain of islets and detached rocks, separated from the coast by intricate and deep canals. The western coast itself is a line of snow-covered mountains, while the eastern parts of the islands, comparatively flat and of Tertiary formation, recall the pampas of the continent.

It has been found that existing maps are in error in many points. The west coast only of Hoste island had previously been delineated, but now the entire contour is known. New Year sound, a great bay filled with islets and ending in four great arms, and the strait between Pothuau and Jaureguiberry islands have been fixed with precision, and the coast line of Wollaston group, composed of the three large islands, Grevy, Bayly and Wollaston, has been determined.

The islands consist of peninsulas joined to each other by narrow low isthmuses. Between these peninsulas run deep fjords, often terminating in glaciers that descend to the sea. Ponsonby sound, the largest of these fjords, penetrates twenty-eight miles into the interior of Hoste island.

GEOGRAPHICAL NOTES.—Professor Hall has made a complete survey of the Waddy Arabah and the Dead sea, with a traverse across Southern Palestine. Akabah was laid down too far south, and the south part of the Dead sea, as shown on the maps, is quite out of its true shape and position. The Lisan has to be shifted three miles.——Mr. Wilfred Powell, with four or five Europeans, including a naturalist and a geologist, will leave England about the beginning of March to explore New Guinea. The intention is to proceed in a steam launch up the Ambernoli river, on the north coast, and then proceed southwards to Astrolobe bay. ——The region of the Pamir has now been thoroughly explored by Dr. Regel and his companions. The valley of the Panj and its tributaries, as far south as Sist (37° N. lat.) and east to Shakddere (72° 50′ E. long.), has been followed up, and an immense bend of this river to the west, due to a high chain of mountains, and a wide lake, Shiva, 11,000 feet above the sea, to the west of this bend, will considerably modify the maps of the west of this region. The great Pamir chain has been crossed in four places, and the whole region has been covered with a network of surveys.——A letter from Dr. Rich. Böhm, dated July, 1883, shows that he and his companion, Paul Reichardt, have settled for awhile at Qua Mpara, on the western shore of Tanganyika.——Mr. Thonar has entertained the Geographical Society of Paris with an account of his search for the remains of the Crevaux mission. Crevaux and his companions were murdered by the Tobas in retaliation for an attack made upon them by the people of Caiza. The victims were killed upon the identical spot where, a few days before, ten or twelve Indians had been killed. Haurat and Blanco, who escaped massacre by swimming the river, were afterwards taken, and died after six months of

captivity and suffering. Ceballos, the sole survivor, was a prisoner for five months. M. Thonar, with his party, visited the scene of the massacre and traversed the mysterious regions of the Chaco with only the loss of a single man, spite of the hostile attitude of the Indians.——Mr. Chas. Winnieke has succeeded in exploring and mapping about 40,000 square miles of previously unknown country in Australia. Distances of from 200 to 300 miles had to be traversed across the highest sand ridges before water could be obtained.——Mr. O'Neill, who arrived at Mozambique Feb. 4, after having traversed 1400 miles of unexplored country between that place and Lake Nyassa, has discovered Lake Amarambu, the existence of which was previously unknown. He reports Lake Shirwa to be smaller than has been represented. On his return he followed the Likelungo valley, which he found to be well peopled.

## GEOLOGY AND PALÆONTOLOGY.

THE MASTODONS OF NORTH AMERICA.—There are probably nine species of the genus Mastodon which may be clearly distinguished as former inhabitants of North America. The genus first appears in the Ticholeptus beds and continues to, if not into, the human period. The statement that this genus occurs in the White River formation is erroneous.[1] The oldest species is probably the *M. proavus* Cope. The Loup Fork epoch contains the remains of eight of the nine species, while one only, the *M. ohioticus* Cuv., is characteristic of later ages.

The following table expresses the characters of these species in analytical form:

I. Intermediate molars with not more than three crests.

*α*. Crests acute, transverse.

*β*. Valleys uninterrupted.

Last superior molar with three crests and a heel; crests low not serrate . *M. proavus.*
Last superior molar with four crests and a heel; crests elevated not serrate *M. ohioticus.*

*ββ*. Valleys interrupted.

Edge of crest tuberculate . . . . . *M. serridens*

*αα*. Crests transverse, composed of conic lobes.

*β*. Valleys ? uninterrupted.

Last inferior molar narrow, with four crests; no accessory tubercles . . . *M. shepardi.*

*β*. Valleys interrupted.

Last inferior molar with four crests and a heel; symphysis short, M. .150; smaller size . . . . . *M. euhypodon.*
Last inferior molar with four crests and a cingulum; symphysis longer, M. .280; size medium . . . . . *M. productus.*
Last inferior molar with five crests and a heel; symphysis very long, M. .450; size largest . . . . . *M. angustidens.*

" *ααα*. Crests broken into conic lobes; those of opposite sides alternating.

Last inferior molar narrow, supporting four crests and a heel. . . . . *M. obscurus.*"

[1] See Report of the U. S. Geological Survey of the 40th parallel, Vol. I, p. 412.

II. Intermediate molars with four transverse crests.

A long symphysis; crests well separated, tubercular, with accessory lobes interrupting valleys ..... *M. campester.*

Symphysis very short; crests thick, closing valleys by contact; no accessory cusps; (Leidy) ..... *M. mirificus.*

The following notes may be made on these species:

*M. proavus* Cope.—The two crested molars of this species are nearly twice as large as those of *M. ohioticus*, leading to the supposition that some of them may belong to the "intermediate" series. This is confirmed by the small number of crests of the last superior molar of an individual from the Ticholeptus beds, which has only three crests and a heel. This molar is a good deal like the corresponding one of the *M. borsoni*, figured and described by Vacek, but differs in the smaller number of crests and in the expansion of the inner base of the external half of each crest, which thus gives a triangular section on wearing. A femur indicates that this is one of the largest species of the genus.

*M. ohioticus* Cuv.—Probably a descendant of the preceding, which represents it in earlier periods.

*M. serridens* Cope, sp. nov.—Founded on a first or second true molar from Texas. It is peculiar among American species in its acute elevated, entire crests, with tuberculo-serrate edges. It thus resembles the *M. turicensis*, but differs in well-developed longitudinal crests at the inner end of the external half of the crests, which consist of two tubercles on the posterior side of a crest, and on the anterior side of the next succeeding crest. Strong anterior and posterior cingula; edge of each cross-crest with six or seven tubercles. Length of crown, M. .130; width, .080; elevation, .061. Length of *M. ohioticus*, but narrower. Found by Henry Brous, M.D.

*M. shepardi* Leidy.—This species is apparently distinct from *M. obscurus* Leidy, but its distinction from *M. humboldti* has not yet been ascertained. California.

*M. euhypodon* Cope, sp. nov.—Founded on a nearly perfect left mandibular ramus with last molar tooth and tusk, with entire palate with both last molar teeth and tusks. The superior tusks are small and have an enamel band, and the inferior tusks are large and have an enamel band. Superior tusks compressed; inferior cylindric. The jaws indicate a small species, but the molar teeth are as large as those of the larger American form of *M. angustidens*, and as long as that of *M. ohioticus*, but narrower. Its symphysis is not prolonged. Length of ramus posterior to symphysis, M. .500; of last lower molar, .182; width of do., .75. The mental tusk is much larger than that of *M. productus* or *M. angustidens*. Diameter of its alveolus, .068. Kansas, Frank Hazard.

*M. productus* Cope.—Loup Fork Beds of New Mexico.

*M. angustidens* Cuv. var.—Lower jaws of four individuals, two of which are nearly complete, show that this species is found in

North America under a slight modification of form. The only difference between our specimens and those of Europe is the greater size of the heel of the second true molar, which is really tetralophodont. It is a larger species than the last two. The best preserved ramus measures M. 1 080 in length, of which .420 is symphysis. Loup Fork beds of Kansas, Nebraska and Dakota.

*M. obscurus* Leidy.—This species rests on a lower last molar of uncertain origin. Its relations have yet to be determined.

*M. campester* Cope.—This very distinct species was found in the Loup Fork beds of Kansas by Dr. R. S. Hill, and described by me in 1879, in the Proceeds. Amer. Philos. Soc.

*M. mirificus* Leidy.—From the Loup Fork beds of Nebraska, found by Dr. Hayden. Resembles most the *M. atticus* Wagn., in dentition.—*E. D. Cope.*

MARSH ON DIPLODOCUS.—In a late number of the *American Journal of Science and Arts*, Professor Marsh describes such parts of the osteology of the genus Diplodocus as are at his disposal. The genus is referred to the Dinosauria, where it enters the division Opisthocœla. It is remarkable in the position of the external nares, which are superior, and between the orbits. The muzzle is declivous in the typical species, *D. longus*, and the teeth are few and slender, and are confined to the anterior parts of the jaws, the maxillary bones bearing but few of them. Two species of the genus are described by Marsh, *D. longus* and *D. lacustris.* The former was probably forty or fifty feet in length.

Professor Marsh believes that the *Diplodocus longus* was a terrestrial animal, and lived on the foliage of forest trees. The character of the dentition indicates soft food, and one not requiring mastication. They might be described as a pair of opposed rakes, like oyster-tongs. The position of the nostrils above the orbits is eminently characteristic of aquatic, and especially of marine animals. It confirms the view I expressed in this journal a few years ago in describing the *Amphicœlias fragilissimus*, that the species of the Opisthocœla were aquatic, and walked on the bottom; their cavernous vertebræ, containing diverticular pneumatic floats, and their solid legs and tail acting as anchors.—*E. D. Cope.*

LITHOLOGY OF SOME CORDILLERIAN VOLCANOES.—A recent article by Messrs. Hague and Iddings (*Amer. Jour. Science and Arts*, September, 1883) gives the results of a study of the volcanic rocks of Lassen's peak, Mts. Shasta, Hood, and Rainier. These cones are andesitic volcanoes, with extrusions of basalt along the slopes and base, and the greatest similarity is said to exist in their lavas. The rocks are classified as basalt, hypersthene andesite, hornblende andesite, and dacite.

The basalt occurs as a light to dark gray rock, sometimes vesicular, and presents macroscopically only small olivine crys-

tals. Microscopically this rock is seen to be composed of ledge-formed plagioclase, irregular grains of light brownish-green augite, colorless olivine, magnetite, and glass. The hypersthene andesite is generally a porous, sometimes pumiceous, rock, varying in color from blue-black to steel-gray, but sometimes red or reddish-gray. Inclosed in the ground-mass are numerous porphyritic feldspar crystals, with some augite and hypersthene. Microscopically the rock is seen to be composed of plagioclase, augite, hypersthene, magnetite, and a glassy base sometimes globulitic, more often filled with microlites of feldspar and pyroxene, and magnetite grains. The hornblende andesite is arranged into two varieties: one near the hypersthene andesite, and resembling it in appearance and structure, but contains hornblende; the other consists chiefly of ledge-formed feldspars, minute pyroxenes, a little magnetite, with or without colorless glass, all inclosing porphyritic plagioclases and hornblendes.

The most interesting rock described is the dacite. This name is given to the rock styled by Richthofen, in 1867, *nevadite* or *granitic rhyolite*, of which Mr. C. King declared, in 1878, that it was "entirely made up of crystalline minerals, with only the slightest traces of vitreous binding material." He also classed it with the rhyolites. In 1881 the present writer pointed out that King was mistaken in his statements of the small amount of glass, and later referred the nevadite to the trachytes.

Hague and Iddings say that they can not regard the rock as in any sense entitled to be classed as a rhyolite, and that it is rich in a glassy base, so far agreeing with the present writer; but they class it under dacite (meaning a quartz-bearing andesite), a term of which he fails thus far to see any need in lithology. Our authors seem inclined to carry the term andesite in its subdivisions to the same extreme that Zabó does the word trachyte—a not unnatural proceeding on their part. The analyses that have been previously made indicate that nevadite belongs to the trachytes, instead of to the andesites. It is described by Messrs. Hague and Iddings as composed of a colorless glass full of gas cavities, through which are found relatively few microscopic crystals of plagioclase, hornblende, mica, pyroxene, magnetite, apatite and zircon, forming a ground-mass inclosing plagioclase, mica, hornblende and quartz, and rarely pyroxene.

The paper of Messrs. Hague and Iddings is in advance of the majority of lithological ones, inasmuch as it attempts to *describe the rocks*, and does not look upon them as small mineral cabinets, regarding which the observer has done his duty when he has described a few of the pretty minerals enclosed. Our authors find that all the above described rocks grade into one another—all possible forms existing between any two types—a view that, in the present writer's opinion, holds good for eruptive rocks of every age the world over. The distribution is given as follows:

Mt. Rainier.—Hypersthene andesite.

Mt. Hood.—Hypersthene and hornblende andesites.

Mt. Shasta.—Basalt, and hypersthene and hornblende andesites.

Lassen's Peak.—Basalt, hypersthene, hornblende, and quartz-bearing andesites (dacite or nevadite).

The paper, from the point of view of our authors and their method of study, is an excellent one, and they are to be congratulated on the results.—*M. E. Wadsworth.*

HEAT AND COLD IN GEOLOGY.—A change of a few degrees in temperature between summer and winter, across the face of a continent, will make a surface expansion and contraction of one mile, every year. This cannot go on forever as an irresistible force without making some permanent changes. It may only affect the upper stratas so much, and it may be relieved by fissures somewhat. But in time fissures may be obstructed, either by minerals deposited from water, or by other means, so something must give way. The upper strata may be gradually compressed, or may slip upon those below. Elevations may slowly rise, or insupportable tensions may occur, causing earthquakes, or even volcanic action.

A less continuous and more striking result may come from the emergence of large areas from the sea. The ocean bed, especially where covered by arctic currents, must be of low temperature to a very considerable depth. Shutting out the arctic current would raise the temperature, and elevation from the sea would permanently raise it from ten to thirty degrees to a great depth. This, however gradual, would produce an expansion which would be irresistible and certainly produce great permanent changes, such as bending and elevation of strata. The bending and elevation might be toward one or both margins, where the cold and less elastic sea bed gave fixed resistance to further movement. Perhaps the lines of elevation would be at right angles to the lines of thrust across broad plains of expansion, to which they might be slightly curved. Such forms are shown in many if not all mountain systems, as if to point to the source of the expansion thrusts producing them. Indeed, such systems may be traced over the globe in such order as to apparently indicate various further laws and considerations affecting the action of this cause. This is a force that has not been duly recognized, which must have produced elevatory and other changes in all geologic ages with inexorable iron grasp, while ice and winds and waves, and streams and sea have worn away. I present it for discussion.—*Sam'l F. Wallace, Keokuk, Iowa.*

GEOLOGICAL NOTES.—*General.*—The Geological Survey Map of England and Wales is now completed; that of Ireland will be finished in a few years; but that of Scotland is far from complete. The work was commenced by Hy. T. De la Beche, at his own expense, and it was through his efforts and tact that the Geologi-

cal Survey was organized, and the Geological Museum and School of Mines established.

*Silurian.*—In a specimen of Asaphus, from the Black Trenton Limestone, Dr. Hy. Woodward has discovered what he believes to be the jointed palpus of one of the maxillæ, in the same position as is occupied by that organ in Apus, Serolis, etc. There appear to be seven articulations in the palpus above the basal joint. He states his opinion that the trilobites should be placed near to, if not actually in, the Isopoda-Normalia (Geol. Mag., Feb.). Dr. I. Mickleborough follows this with an account of a specimen of *Asaphus megistos*, in which ten pairs of jointed limbs are clearly seen.——Dr. Reusch, in a volume recently published at Leipzig, describes the Silurian fossils found by him in highly altered rocks in the Bergen peninsula, Norway. The shells of the fossils have disappeared, and only a reddish colored earth remains; yet the trilobites, Phacops and Calymene, and the corals, Cyathophyllum, Halysites, etc., with some graptolites, can be identified.

*Triassic.*—Herr H. Kunisch describes and figures (Zeit. der Deutsch. Geol. Ges., 1883) the adult stage of *Encrinus gracilis* from the Muschelkalk; and in a succeeding paper, Herr K. Picard describes and figures *Encrinus Beyrichii*, a new species from the Muschelkalk, near Sondershausen. All the joints of the stalk are pentagonal.——At a recent meeting of the Geological Society of London, Professor Owen described the skull and dentition of *Tritylodon longævus*, from South Africa. The teeth resemble those of *Microlestes*, from the Keuper of Würtemberg, and those of *Stereognathus*, from the Oölite.

*Jurassic.*—W. H. Hudleston (Geol. Mag., Feb., 1884) contributes some notes upon the Gasteropoda of the Oxfordian and Lower Oölites, and describes four new species of Cerithium.——Professor Owen, at a recent meeting of the Geological Society of London, separated the Kimmeridgian *Plesiosuchus Mantelii* from the genus Steneosaurus, on account of certain peculiarities in the skull, teeth and vertebræ. It approaches nearer to the recent crocodiles than the older oölitic type.——J. W. Judd (*Nature*, Feb. 7) notes the undoubted occurrence, in a well bored at Richmond (Surrey, England), of a stratum of oölitic limestone eighty-seven and a half feet thick, with some subordinate clay bands, one of which was crowded with fossils of the age of the Great Oölite. Sandstone, evidently triassic, occurred under this stratum, and pebbles of Coal-measure sandstone, with fragments of anthracite, seem to indicate the presence of an anthracite bed below. The Jurassic and Triassic have never before been certainly identified as present below London, but this discovery shows that some anomalous strata found in other borings were really Jurassic.

*Tertiary.*—Herr W. Dames (Zeit. des Deutsch. Geol. Ges., 1883) describes *Cervus pentelici* and *Mus Gaudryi*, from the pliocene of Pikermi in Attica.——Restorations of the crocodilian *Diplocyno-*

*don ratelii*, and the turtle *Ptygogaster emydoides*, have been made for the museum of the Academy of Sciences of Paris. The remains from which the restorations have been made were put aside eighteen years ago by M. A. Milne Edwards, when he wrote his great work on fossil birds, and were taken, like most of M. Edwards' material, from the lower miocene of Saint-Gerand-le-Puy (Allier). Notwithstanding the smallness and great number of the pieces, M. Fischer has succeeded in joining together the head, all the vertebræ, some ribs, most of the members, and a great part of the bony plates of Diplocynodon, which M. Vaillant believes to be nearly related to Jacare.——In the Bulletin de la Société Geologique de France, Dr. Lemoine describes two casts of the brain mould of the crocodile *Thoracosaurus macrorhynchus*. These remarkable specimens are much like corresponding casts of the modern gavial, but present relatively rather smaller cerebral hemispheres.

*Recent.*—Herr D. Brauns (Zeit. des Deutsch. Geol. Ges., 1883) describes the diluvial mammals of Japan, and arrives at the conclusion that the geology, flora, pliocene molluscan fauna, and fossil land-fauna of Japan, prove that that country is most intimately connected with the Palæarctic region, and that it is only very recently that it has become a disrupted portion of the Eastern continent.

## BOTANY.[1]

An enormous Puff-ball.—My friend, Professor R. E. Call, has handed me a photograph of a puff-ball, the largest on record. The fungus was found by him in Herkimer county, N. Y., in 1877, and as it was impossible to preserve it, careful measurements were made, and photographs of it were taken. It was irregularly oval in outline, and much flattened, instead of approaching the spherical form, as is common in the large puff-balls. Its largest diameter was *five feet and four inches*, its smallest *four feet and six inches*, while its height was but nine and a-half inches. In referring to it Professor Call described it as "much larger than the largest wash-tub we had at home."

The specimen undoubtedly belonged to the species known as the giant puff-ball (*Lycoperdon giganteum*), and it was by far the largest of any of which I have been able to find measurements.—*C. E. Bessey.*

Notes on Fungi.—Among the more interesting fungi are some of the various forms embraced in the genus Polyporus, of which over 1000 species have been described. The species of this genus are not as numerous as those of the genus Agaricus, of which the common mushroom is a well-known type, but they are not less interesting in the great variety of the forms they assume and in the universality of their diffusion. The Polypori most commonly noticed are probably those growing on dead trees or logs,

[1] Edited by Prof. C. E. Bessey, Ames, Iowa.

and standing out from the trunk or log like the front piece of a cap, and varying in size from one inch to two feet across, and varying in texture from a soft, juicy, fleshy substance, which decays almost as soon as it has finished its growth, to the hard, woody or corky species that endure for several years, and before the introduction of lucifer matches, furnished the tinder to catch the spark from the flint and steel. If one of these Polypori that grow on trunks of trees is carefully examined, it will be seen that the under side is full of small holes, which are really the mouths of closely-packed tubes extending up for some distance and forming no inconsiderable part of the entire mass. These tubes or pores are always present in every Polyporus, and form the distinctive character of the genus, as is indicated by the word itself—polyporus signifying *many pores*. These tubes or pores vary considerably in size, but are always small, often finer than a cambric needle and not generally larger than a common pin. Their arrangement and appearance is like that of the cells in a honeycomb, and like these they are often more or less angular though normally cylindrical. This system of pores constitutes the *hymenium* in which the seeds, or *spores* as they are called, are produced. When examined with the microscope the inner surface of these tubes is found to be studded with little cylindrical projections, from the rounded apices of which arise generally four short, straight, transparent horns, each bearing at its tip a single minute, globose or oval spore. These spores soon fall from the points of their attachment, out of the tubes in which they grew, in such quantities as to give their own color to any object on which they chance to fall—generally white or rust color—always the same in the same species; the color of the spores, however, in Polypori does not appear to present as great a variety of shades as among the Agarics, but this may be because in the Polypori the color of the spores is not as readily seen, as from some cause they do not appear to be as readily and as copiously discharged as in the Agarics. Another peculiarity of the genus Polyporus is, that the direction of the pores is always *down*, so that in *resupinate* forms on a vertical surface, *i. e.*, on the side of a tree or log, the *sides* of the pores are exposed instead of their mouths. This downward tendency is finely illustrated in a specimen of *Polyporus igniarius*, which I lately found on the trunk of a dead oak that had fallen and lodged on another tree at an angle of about 45°. The Polyporus had commenced its growth while the trunk was standing, and had continued to grow after the trunk had fallen, as was apparent from a bend or angle of about 45° about midway in the length of the pores, so as to continue their growth directly downwards.—*J. B. Ellis, Newfield, N. J.*

CROSS-FERTILIZATION IN LOBELIA, &C.—E. Haviland, in Proc. Linn. Soc. N. S. Wales, VIII, pp. 182–86, describes the development of the stamens and pistil in species of Lobelia. The anthers

are closely united in a cylinder. The pollen is shed inside and pushed out by the hairs on the growing style. After the pollen has withered, the apex of the style splits and expands its lobes. The writer considers that cross-fertilization is the almost invariable rule. He also notes (p. 289) the contrivances for cross-fertilization in Leptospermum, a genus of Australian shrubs.—*J. F. J.*

WATER FROM EUCALYPTUS ROOTS.—In many parts of Australia, where water is scarce, the natives formerly procured it from the roots of the Eucalyptus and a few other trees. The tree most preferred throws out numerous lateral roots, which lie at a depth of from six to twelve inches below the surface. According to a writer in the Proc. Linn. Soc. of N. South Wales (Vol. VIII, 1883), the native having ascertained, by means of prodding with a pointed stick or spear, the position of some of the roots, "removes the superincumbent soil with his wooden shovel for twenty or thirty feet, and cutting the root off at each end lifts it out of the trench and cuts it up into lengths of about eighteen inches or two feet, knocks off the bark and stands the several portions on end in some receptacle to contain the water. * * * As soon as these pieces are placed on end, the water commences to drip, and when the whole of the root or roots are cut up and placed on end, the native, beginning at the first placed, puts the end in his mouth and by a vigorous puff expels the remaining water. * * The water is beautifully clear, cool and free from any unpleasant taste or smell."—*J. F. J.*

STURTEVANT'S STUDIES OF MAIZE.—In a privately distributed pamphlet, just received, Dr. Sturtevant, the director of the N. Y. Agricultural Experiment Station, sets forth the results of some of his studies of the varieties of maize. A large number of excellent cuts enable the reader to obtain clear ideas respecting the structure of the mature kernels. An attempt is made to classify the varieties, and there appears to be some ground for hoping that it will not be unsuccessful. From a careful study of many kinds of maize, grown upon the grounds of the experimental station, Dr. Sturtevant is led to the conclusion that at least five well-marked species may be recognized. At present he denominates these agricultural species, and distinguishes them from the species of systematic botany by a star (*) placed between the generic and specific names.

These species are as follows:

1. *Zea* * *everta*, the pop corns.
2. *Zea* * *indurata*, the flint corns.
3. *Zea* * *indentata*, the dent corns.
4. *Zea* * *amylacea*, the soft corns.
5. *Zea* * *saccharata*, the sweet corns.

In the foregoing, if the kernels be split parallel to the embryo the pop corns show only a corneous endosperm; in the flint corns a corneous belt surrounds an interior softer tissue; in the dent

corns the softer tissue extends to the apex of the kernel, and is bounded by a column of corneous tissue on each side; the soft corns have no corneous tissue; while the sweet corns are composed of a translucent and more or less shriveled corneous matter.

Each of these species is divisible into several sub-species or races, which exhibit remarkable permanence. In fact, one of the unlooked-for facts brought out by these observations of Dr. Sturtevant, is the permanence of the several types, whether of species or races, as indicated below.

The following general conclusions are recorded:

"Cross-fertilization of the current year is manifested on the kernel and not on the ear, and this influence is not reciprocally strong as between the races [species] or even the sub-races, and the resistance to current hybridization is more strongly marked in some races [species], sub-races or varieties than in others.

"Hybridization in the seed used produces a variety of ears, but each ear in general is quite close to one of the parent types; an intermixture of kernel in no case seems to be produced. Reciprocal fertilization between two races [species] does not seem to be productive of equal effect."

CURTISS' SEVENTH FASCICLE OF NORTH AMERICAN PLANTS.—This welcome package, with its fine specimens, was distributed to botanists in February. Like its predecessors it contains many species of great interest, especially to Northern collectors. Most of the NATURALIST readers are aware that Mr. Curtiss has been collecting for many years in Florida, and that his specimens have found their way into most of the great herbaria of this country and Europe.

ANOTHER BOTANY.—Some time ago our attention was called to another text-book of Botany, prepared by Dr. Kellerman, and brought out by the house of Potter & Co. of Philadelphia. We hoped for the sake of the younger botanical writers to be able to commend this effort of a new author, but candor and a consideration for the readers of the NATURALIST compel us to say that the work has been poorly done. Naturally the book is a compilation, but this has been, as it appears to us, unwisely and injudiciously done. Parts I, II and III contain numerous cuts, definitions and expressions which have evidently been boldly copied from well-known text-books without the remotest acknowledgment. However, had this questionable method of compilation given us a reliable text-book, the pupils in the schools would have had no reason for complaining; but, as is inevitable in such book making, the several parts so brought together do not fit well; hence, we find statements in one part contradicted in another. The announcement is made on page 4 that the author has in preparation a manual of the wild flowers of the northern United

States, a field now occupied by Dr. Gray's and Professor Wood's manuals. It is to be hoped that Dr. Kellerman's second book will be a less verbatim compilation than his first has been.

Botanical Notes.—We have examined Professor Groff's Plant Analysis, published by the Science and Health Publishing Company of Lewisburg, Pa., and can commend it to those who wish a cheap and yet good help of this kind.——Dr. Farlow, in the March *Botanical Gazette*, makes a number of interesting additions to his previous list of Peronosporeæ.——In a recent number of *Nature*, Dr. Schweinfurth contributes an interesting paper on the flora of ancient Egypt. As is well known, the funeral wreaths preserved in the mummy cases have been objects of study by botanists for some time, and through these we now know much as to the common plants of the Nile region thirty to thirty-five centuries ago. The evidence as obtained shows that some important migrations have taken place during the time which has elapsed since the wreaths were gathered. On the other hand, there is evidence that some plants have, through this long period, preserved not only their places in the flora, but their specific and varietal characters as well.——The last part (No. 7, Algæ) of the new edition of Rabenhorst's Kryptogamen Flora brings Dr. Hauck's work up to the Phæozoösporeæ.——It gives us great pleasure to learn that the New York Agricultural Experiment Station has secured the services of Professor J. C. Arthur, who is to be the station botanist. The director of the station is to be congratulated upon his wise selection, which is an indication that *plant life*, rather than *plant names*, shall receive the greatest attention of the station.——Thomas Hick, in the March *Journal of Botany*, concludes his paper on protoplasmic continuity in the Florideæ. He says in conclusion, after having examined many species of widely different genera, "It seems clear that, if not universal, protoplasmic continuity is very widely distributed in the Florideæ," and further on, in explanation of this phenomenon, "The process of cell-division appears never to proceed so far as to completely separate the different portions of a divided protoplasmic body, so that they remain connected together by one or more threads of protoplasmic material."

## ENTOMOLOGY.

Gills of Insect Larvæ.—In an article on this subject in *Psyche* (iv, 110, 1883), Professor G. Macloskie states that it is usual to describe the laminæ of the pneumatic gills as containing systems of fine tracheal loops, somewhat after the pattern of a plurality of carbon-wicks in an Edison lamp. In a specimen, however, of the rectal branchiæ of the larval Libellula, which he rolled under the cover-glass, he found that the multitude of tracheal ramifications ended cœcally; all were of about the same

length, their extremities recurved within the containing sac, and their tips not at all swollen, but rounded off. "As they are elastic, and the closing sac distensible, we think it highly probable that with each water-inspiration the sacs enlarge and the tracheal spray (having air forced in by the forward compression of the large tracheæ) spreads out so as to bring the full tide of air close to the tide of water. Léon Dufour, seems to have had some process like this in view, when he said that each lamella of the branchia of Potamophilus is 'probably swollen during life by air transmitted by endosmosis.' As we understand the case, the air is injected into the branchiæ from the rest of the body by rhythmical contractions, and its gases then communicate endosmotically with those in the tidal waters, so as to secure renovation." The action of the tracheæ, Macloskie believes to be tidal rather than due to peripheral capillary circulation; there being a flux and reflux, rather than a mere circulation of the air.

THE CLOSED POISON GLANDS OF CATERPILLARS.—Dr. Dimmock, in the course of a valuable article "on some glands which open externally on insects," in *Psyche*, for "Sept., Oct., 1882" (published in Feb., 1884!), states, that if a Cecropia caterpillar "be examined carefully, the black spines upon its red, blue, and yellow knobs, or tubercles, will be seen to break easily from the tubercles, and a clear, yellow fluid of disagreeable odor to ooze from each opening left by the injury. By crushing the tubercle with a pair of forceps, the same strong odor is very noticeable, and by this mode of treatment one has no difficulty in proving that each tubercle, small or large, blue, yellow, or red, contains the odorous fluid. The red tubercles are seen, in sections cut with the microtome, to be divided into compartments, the cavities of each spine opening into a compartment at its basal end. The spines themselves are quite rigid and very brittle, so that they break away at a slight touch and leave a hole in the tubercle, out of which the odorous fluid pours, pushed by internal pressure. This fluid, which I have not examined carefully, but which I hope later to study chemically, is strongly acid to litmus paper, but causes a purple precipitate in carmine solution." The odor given out by these glands suggests at once their protective function. Similar glands, *i.e.* with no outlet until one is produced by external agency, are not rare in Bombycid larvæ. Karsten, in 1848, described the anatomy of the poison glands at the base of the hairs of an American Saturnia. The secretion is "perhaps formic acid or a formate in solution." The paper is crammed with interesting facts on this subject. Among others it is stated that, according to Witlaczil, the "honey" secreted by the Aphides issues from the anus and not from the tubes on the sixth segment.

THORACIC MUSCULATURE OF INSECTS.—C. Luks has investigated the thoracic musculature of insects of every group, except

the Thysanura and Collembola. He finds, according to the Journal of the Royal Microscopical Society, that the wing-muscles appear to have developed along two lines; in one, the indirect flying muscles were almost completely aborted, while in the other they were developed at the expense of the direct muscles. In close connection with the development and modification of these muscles is the extent of concentration of the rings of the thorax and the size of the wings. In the Orthoptera all the three segments of the thorax are freely movable on one another, while in the Coleoptera only the prothorax is so movable. In the Lepidoptera the prothorax loses its mobility, though retaining its distinctness, while in the Diptera and Hymenoptera the whole region is converted into a firm thoracic apparatus, to which, in the latter, the first abdominal segment also becomes applied. As Graber has shown, we observe that in insects which by other points in their organization intimate that they are more highly developed, one pair of wings tends to become aborted, as is seen in the Coleoptera, Diptera, and even Lepidoptera, where the hinder pair of wings often become united with and share in the movement of the anterior pair.

Respiratory Center of Insects. — According to Dönhoff, the respiratory center in the bee is situated in the anterior ganglia, and therefore the respiratory movements are put an end to by decapitation. Dr. O. Langendorff, from his investigation, finds that in the bee, wasp, and other insects, the respiratory movements are not destroyed by removal of the head, especially when by *tearing*, and not *cutting* it off, a great loss of blood is avoided, the respiratory movements show the same increased rapidity with a high temperature, slowing with a low temperature in the headless insect as in the uninjured insect.

A number of experiments were also made upon *Libellula depressa* and other insects belonging to the Pseudoneuroptera, in which group the segmentation of the body is very marked in correspondence with their ancestral type; in these insects the respiratory center is not merely not localized in the head, but each segment is a complete center in itself, being capable of respiratory movement, when entirely isolated. "A better example to illustrate the physiological metamerism of the insect body can hardly be imagined; each segment with its ganglion is a physiological unity!" The results of a great number of observations are fully stated in the paper, and several diagrams are given of tracings obtained of the respiratory movements.—*Journ. Roy. Mic. Society, February.*

Mouth-parts of the Hemiptera.—O. Geise regards the flattened or more or less curved process of the clypeus of the Rynchota as the homologue of the labrum of beetles; the jointed groove corresponds to the labium, the two separable setæ to the

mandibles, and the two setæ, only with difficulty separable, to the maxillæ of biting insects. He next considers the structure which Savigny regarded as the lingula, but to which most authors have applied Burmeister's name of "Wanzen-platte;" he himself proposes to speak of it as the pharynx, and describes it as being endowed with great elasticity, and as acting as a pump, which is set in action by the contraction of muscles attached to the body-wall, whereby the space in the walls in which they are inserted is enlarged, and a vacuum thereby formed. The structure and relations of these parts are entered into in great detail, but, says the Journal of the Royal Microscopical Society, a full abstract of the paper would be impossible without a republication of the figures to which constant reference is made. The essay should receive the careful study of students of the anatomy of insects.

Chlorophyll in Aphides.—L. Macchiati, having noticed that certain Aphides, when placed in a dark situation, lost their color in the same way that leaves do, investigated two species, *Siphonophora malvæ* and *S. rosæ*, with a view of ascertaining whether they contained chlorophyll; he discovered, by applying the usual test, that chlorophyll was undoubtedly present. The objection that this substance is absorbed from plants by the insects, and not elaborated in their own bodies, is met by the statement that it is also to be found in those species that live upon the colored petals of flowers. The conclusion arrived at needs to be confirmed "by a more matured study," and M. Macchiati promises a fuller investigation of this interesting discovery.—*Journal of the Royal Microscopical Society.*

Ayers' Development of Œcanthus niveus and its Parasite, Teleas.—This is an extended, thorough, and well illustrated memoir on the embryology of the tree cricket, and its egg parasite, by Howard Ayers, a student of Professor E. L. Mark, at Cambridge, Mass. It received the Walker prize of the Boston Society of Natural History, in whose memoirs it appears, under date of January, 1884, forming a brochure of 56 pages, with eight plates and woodcuts in the text. Mr. Ayers endeavors to establish the following points in the embryology of Œcanthus:

1. The origin of the ovum in a germarium rather than from an ovarian epithelium.

2. The process of yolk formation by cell-degeneration instead of secretion.

3. The occurrence of a primitive segmentation of the embryo before the appearance of the permanent segments.

4. The existence of a pair of appendages (some of them rudimentary [deciduous]) on each of the seventeen segments of the body.

5. The origin of the dorsal vessel as a paired organ, the lateral halves of which fuse and give rise to a median tube in the same

manner as in some of the worms, and the origin of the blood corpuscles as nucleoli of endodermic cells.

6. The existence of embryonic gills.

7. The lack of any sharp distinction between a cell and its nucleus, and between a nucleus and its nucleolus.

8. The existence of segmental enlargements of the mesodermic somites, similar to those from which the nephridia of worms take their origin.

9. The origin and significance of the embryonal membranes among the insecta.

10. The origin and significance of the dorsal organ among the insecta.

Among the chief points of interest is the mode of formation of the blastoderm. No nucleus was observed in the fertilized eggs, even in those which had been only laid from one to twenty-five minutes; and in the ovarian egg after the disappearance of the germinative vesicle no traces of nuclei were to be found. When the blastoderm is partially formed, however, there are always numerous amœboid cells to be found throughout the yolk. These nuclei form the blastoderm in the following manner: the pseudopod-like processes sent out by a few of those migrating to the surface of the yolk fuse together, and furnish by rapid division a sufficient number of cells to form the blastodermic membrane. This mode is the same as observed by Bobretsky in the Lepidoptera. There is no segmentation of the yolk.

The fact that at first the embryo is composed of four well-marked regions, which the author designates as the "cephalic, maxillary, thoracic, and abdominal," is interesting. The author does not attempt to compare this feature with the earliest stage of the spider with its protozonites, as discovered by Claparede, but the resemblance is at least a striking one.

The process of turning of the embryo is clearly described and figured. After giving a summary of the development, attention is next directed to the mode of formation of the different organs. The novel points worked out are the origin of the heart and the discovery of so-called gills, and the relations of the germinal layers.

The formation of the heart begins after the revolution of the embryo; it is first to be distinguished in the abdominal region about the time of the closure of the dorsal ectoderm. "In the formation of the heart, the lateral plates of mesoderm grow upward around the mesenteron, and as their edges approach the median dorsal line there is seen to be in each a tube. These two plates coalesce in the median line, and their tubes unite into one—the heart, or dorsal vessel."

The discovery of the "gills or respiratory organs" which Mr. Ayers describes is rather startling. A pair of lateral outgrowths arise from the ectoderm of the pleural region of the first abdominal

segment, and "come to lie just behind but dorsad of the base of the third thoracic appendage." The internal cavities of each gill "are continuous with the body-cavity, and probably serve as channels through which the vascular fluid circulates." In sections of the gill-organ before becoming atrophied or absorbed, both distinct canals and lacunar spaces radiate from the point of connection of the pad with the body; "and these, together with the arrangement of the cells, give the radiate structure characteristic of the fresh gill." "The gill pad is essentially a single-layered sac, with a much constricted neck, evaginated from the pleural region of the abdomen." It should be observed that these are not tracheate gills, as they contain no tracheæ. Mr. Ayres does not speculate as to their origin.

While not accepting Balfour's interpretations and general conclusions as to the origin and significance of the primitive germinal layers among the insecta, Mr. Ayers confesses himself still in doubt as to their origin. But, he adds, "when we consider the rôle and subsequent fate of these two layers, it at once becomes apparent that such a view does not accord with the facts, for the blastoderm ultimately forms the entoderm (mesenteron), and the ectoderm, arising from a small area of thickened cells on one side of the blastoderm, encloses the yolk and endoderm by a genuine epiboly." With some hesitancy he then proposes an explanation which may apply to the Orthoptera: "How did the embryonic membranes (amnion and serosa) arise? What is their function? Is their present function the primitive one? The answer to these inquiries undoubtedly lies in the clear comprehension of the relations of the embryo to its food supply—the yolk. That the cellular embryonic membranes could have originated for protection, or from an early ecdysis, is, to say the least, highly improbable. Among the insecta the egg is furnished with a *protective membrane*—usually in the form of a chorion—before leaving the body of the parent. Omitting the interesting and original explanation in full, the result is that "in Œcanthus the membranes fuse at or near the head, and by a self-eversion through the opening caused by their rupture the embryo comes to lie outside of the amnion and serosa. The latter now forms a yolk sac, which, by a gradual contraction, as the yolk is absorbed, comes to lie within the body, being last seen just back of the head. It is always in connection with the mesenteron, and its thick walls finally disappear by a process of disintegration." The author thinks that in many, if not all, insects, the serosa and amnion play the same rôle that they do in Œcanthus, *i. e.*, "the serosa functions as a yolk sac, while the amnion is the dorsal wall of the insect. Hence the so-called dorsal organ is but the remnant of the yolk sac."

It is interesting to compare the history and function of the serosa and amnion in two branchiate Arthropoda (Limulus and Apus), in which, Limulus at least, the serosa does actually become

what we have called a "vicarious chorion," and after the chorion or egg-shell splits, becomes a protective membrane.[1]

Mr. Ayers' observations on the egg-parasite, Teleas, are full and valuable, showing, as he claims, the absence of embryonic membranes, and the occurrence of a larval form intermediate between the blastosphere and the cyclops larva of Ganin.

The illustrations are admirably clear, but the plates are too much crowded; this, however, is not the fault of the author.

A Possible Sense Organ in Campodea.—Several years ago, when studying Campodea, I found on the terminal joint of the antennæ what may prove to be a possible sense organ. On the tip of this joint is a body closely resembling a couple of beans placed side by side and supplied by the tip of the antennal nerve. The general relations are shown in the accompanying figure. I regret that I have no further observations which would tend to show the histology or functions of this organ. I mention it at this time to call the attention of others to it, in the hope that our knowledge of it may be increased.

My reason for supposing it a sense organ are the way in which it is supplied with nerves and also its general resemblance to what Dr. Packard has considered as sense organs in the caudal stylets of Chrysopila and the palpi of Perla.

A further feature which may here be mentioned is the power which Campodea has of retracting its antennæ. Ordinarily they are extended to their full length, and then present a moniliform appearance. The insect can, however, by the action of appropriate muscles, so draw the joints into each other that they present the appearance shown in my figure. I have noticed a similar capacity in Scolopendrella.—*J. S. Kingsley, in Science Record.*

Lucilia macellaria infesting Man.—A farmer's wife, thirty-five years of age, was attacked on Monday, September 27, 1875, with a headache and a flushed face. She stayed at work, expecting a malarial chill, an affection prevailing at that time in the neighborhood. From this time the pains in the region of the frontal cavity, at the base of the nose and below the eye, extending to the right ear, increased. At times the pain was more severe than at others, but it never entirely left. This pain was described as preventing hearing and breathing, and so excruciating that at intervals, day and night, her cries could be heard at a great distance from the house. Tuesday evening blood mucus began to run from the right nostril, which was somewhat swollen,

[1] See The Development of Limulus polyphemus. By A. S. Packard, Jr. Mem. Bost. Soc. Nat. Hist., March, 1872, p. 160, 161.

the swelling extending on Tuesday over the whole right side of the face. On this day, the fifth of the complaint, four large maggots dropped out of the right nostril. When I was first called to the patient, Monday, October 4, only the right lip and nostril were swollen, the acrid discharge having somewhat blistered the lips below. After each discharge the maggots dropped from the nostril, until the twelfth day; one hundred and forty or more maggots having escaped. The majority of the maggots were three-fourths of an inch in length, there being only a few which seemed a line or two shorter; they were of a yellow hue, conical shape, and having attached to one end two horn-like hooks. The patient recovered fully.

Monday, September 18, 1882, I saw a patient in the same neighborhood as the first, suffering from the same malady. At that time two hundred and eighty maggots had been discharged, and at the close of the illness, over three hundred. There was a swelling on each side of the nose, with a small opening to each. I lanced these openings, and more maggots came out.

In the Indian Territory the so-called screw-fly laid its eggs in the nose of man. In 1847, I heard of several deaths of men and children in Texas, near Dallas. The gad-fly was common in the American bottom forty years ago. It laid its eggs in the noses of cattle, and in the ears of horses and deer, but never in the human nose. The fly that I send is about four times as large as the common fly. Head a dark, glistening green; a bronze face, very lively in appearance. Is it the same that they called in Texas or Indian Territory the screw-fly? or is it the gad-fly seeking a new field?

The patient of 1875 is now alive and well. The second case occurred two years ago, near Collinsville, in this country, and proved fatal. The third patient, above named, is getting well. The fourth is reported from Georgia; the patient died.

The first case which I had in my charge was the first which ever occurred here. The eggs must have been deposited in the nose several days before the fifth, the day the maggots dropped out. On the eleventh day all were discharged. I secured live maggots at that time, September 18, 1882. I put soil in an open-mouthed vial and dropped the maggots on it; they crawled in the ground in about five minutes. I covered the opening with white damastis, and hoped that the next year the fly would come out of the ground. But on October 6, or the twentieth day, the vial had fourteen living flies. So, reckoning from six days before the pain commenced for the laying of the eggs, to the twelfth day, when the maggot discharged, making eighteen days, and to this adding the twenty days during which the grubs were in the ground, we have thirty-eight days from the time the fly laid the eggs until a new generation of flies is produced from them.

You may think I have dwelt too long on these cases; but if

you had to stand at the bed and had seen the suffering and despair of the patients, and found that the worms were eating them up, you would not think so. All these cases occurred in the month of September.—*Fred. Humbert, M. D., F. C. S.*

[Upon this communication Dr. C. V. Riley says, that the insect here referred to as attacking a human subject in Illinois, "is the *Lucilia macellaria* of Fabricius, the injuries of which to different animals are well known in the South and West, where the larva is called the 'screw-worm.' I have repeatedly endeavored to obtain the true parent of this worm. Dr. Humbert's communication is most interesting, but the specimens yet more so, as the flies he forwards are the first that have positively been bred from the larvæ known as 'screw-worms,' and they confirm the above determination of the species. The larvæ agree with others which I have from Texas, taken from the root of the ear of a hog which had been bitten by a dog."]—*Proc. U. S. Nat. Mus., Sept., 1883, p. 103.* Compare also Professor F. S. Snow's article in *Psyche*, Mar., Ap., 1883, and S. W. Williston in *Psyche*, Nov., Dec., 1883. —Eds. Naturalist.

Entomological Notes.—G. W. and E. G. Peckham have published in the Proceedings of the Davenport Academy of Sciences detailed descriptions of twenty-five species of spiders of the family Attidæ, illustrated by three rather rude photo-lithographic plates. The authors, who live in Milwaukee, are engaged upon a monograph of this family, and desire specimens of the group from all parts of the continent; they have made a good beginning and should receive aid from all quarters.——An account of the transformations of *Aglossa pinguinalis* by the late W. Buckler, appears in the *Entomologists' Monthly Magazine*, for February. So far from living on fatty substances, as stated by Rolander, which led Linnaeus to give it its specific name, Buckler states that it lives in comparative darkness, in stables, barns, and out-houses, in masses of rubbish, hidden within a protecting sheath or galley nearly or quite close to the ground, composed of materials in which they find both their food and their covering; "unless disturbed, they are never to be seen whilst growing, as they do not voluntarily leave their abodes until full-fed; but then only do they desert their quarters, and may occasionally be observed ascending walls to find a suitable place for pupation."

## ZOOLOGY.

Atavism Considered as a Conservative Agent in a State of Nature.—Atavism, although a very important factor in the preservation of species, receives but little of the recognition it deserves as such; because its action in nature is not superficially apparent enough to command attention and observation, and so, though ancient in name as well as existence it may still, as far as practicable observation goes, and to all intents and purposes

be considered in its major and readily recognizable manifestations as a resultant of artificial selection, being a concomitant upon the notable unstability of forms so produced; as it rarely, if ever, occurs in appreciable degrees in organisms which have been uninfluenced by man's fostering care.

Because nature changes and develops her products so slowly that when a modification does take place, the adaptation called for, owing to the all-powerful unyielding inorganic evolution, which may be regarded as the primal cause in the production and continuance of organic evolution, is nearly always different from any of the requirements that preceded it; and the tendency is rather to gradually depart still further from the ancestral branch than to revert back towards it.

By domestication, while we, as it were, magnify the natural tendency towards variability, we also at the same time, through organic correlation, increase its coördinate force, atavism, and by this means make it apparent to the most superficial observation, and thus enable us, as has been done in the case of artificially exaggerated variability, to reason by analogy of its existence under natural conditions and of its function and mode of action there.

For while it is probably one of the most frequent and powerfully operative forces brought to bear upon organisms in a state of nature, it is confined within comparatively narrow limits, and depends rather upon continuous action, as with its collaborators, direct heredity and variability, each separate coëfficient, of which there may be several acting synchronously in the same individual, unites in producing evenly blending results with its fellows, and is bounded by the first fixed varietal characteristics existing in the immediate ancestral line.

In domesticated varieties the nearest strongly fixed point, notwithstanding the number of changes they may have undergone, or the length of time they have existed as such, is generally the ancestral feral stock, which had become stable by reason of the prepotency of natural selection.

This is especially manifest in the case of color for reasons to be noted further on. In nature its manifestations are so slight as to escape the most critical observations, necessarily, from want of proper conditions for study without trammeling and thereby modifying to a greater or less extent the species brought under observation. The characters produced by artificial selection, as exhibited in domesticated organisms, become stable only in a secondary degree and by lesser causes, namely, on account of their usefulness to man, and are preserved only through his continued supervision. That they would be, and are, as a rule, detrimental to the organisms if left to themselves, is, of course, self-evident. Consequently, they can never become so potent as characteristics derived through the agency of natural selection,

and fixed by the primary cause of prepotency, usefulness to the individuals themselves.

The function of atavism is in all probability that of serving as a restraining influence against what might otherwise be a too rapid divergence in any one direction, before surrounding and semi-dependent parts, and special instincts have become modified in such a manner as to functionate harmoniously with it. To illustrate; a too sudden change of color presenting itself, and becoming inherited in a species of bird, dependent upon it to a certain extent for protection, would, if occurring before its mental attributes had sufficient time to evolve with, and adapt themselves to it, tend towards the extinction of the individuals manifesting it, from a failure of the instinctive actions to properly perform their offices in producing the protective effects intended, while the individual cases of atavism of color, with unchanged instincts, would escape. So by the continual preservation of individuals occurring in any untoward varietal forms, atavism became a fixed law, acting as a governor to the organisms over which it holds sway, and so equalizing and neutralizing the forces and inherent tendencies towards individual and consequent specific variability, as to best serve their interests. Though in it we may also find the explanation of the extinction of some of the great races of the past, in whom, on account of the want of proper incentives to struggle for existence, they remained stationary long enough to allow it to become thoroughly fixed, and thus become so prepotent over the natural adaptive inclinations of variability by the action of selection to assume the new and necessary modifications demanded by changes of environment, as to counteract all such tendency, and, by so overreaching itself, in fact, become suicidal in its nature.

The primal cause of atavism, and the reason for such an inheritance, is found in the knowledge that all animals preserve and pass through the same embryonic stages as their immediate ancestors, as well as retaining landmarks of the more prominent changes through which they in their evolution have passed. In nearly related species the individuals do not differ perceptibly until near the latter part of the embryotic period, and in many not until after it has been passed.

Individuals at times come in contact with disturbing, physical, or nervous influences, by which some change in the system, that arrests embryological developments to a greater or less degree, in one or more parts, takes effect at the time when those certain stages of varietal divergence are being developed.

An arresting of divergence does not necessitate the loss of power to develop to maturity, but will often produce what might be termed premature development. Therefore the varietal evolution being arrested by certain disturbing influences, certain varietal germs are aborted, and the product is a preparental form or rever-

sion to one or more varietal ancestral characteristics. Under domestication color is more subject to change than any other feature. The principal reasons for this being, first, that it does not require for its production a correlative diversification of adjacent features. Any organic change of form necessarily causes some modification of the surrounding tissues and adjoining parts, thus requiring more time, energy, and force than a mere slight change of the color-secreting tissue. Second, as it is comparatively so easily affected, it has been subject to more of the passing whims and fancies of mankind than any other part, especially as it does not require the patience necessary to produce a change of form or feature.

Therefore, from already being one of the most unstable characters, man has rendered it still more so by the comparatively rapid changes that it has been compelled to undergo under the dictation of his selective inclination. Being so susceptible to variation from the parental marking and coloring, it is also the part in which we should expect atavism to occur most frequently, as is the fact.

As a theoretical illustration we will represent the development of a domesticated bird, from the beginning of life in the egg to the adult, by *A* to *Y a*, which will represent the young, and *Z a* the adult, *a* representing coloration. And a variety produced by artificial selection from the parent stock by *Z 1 b* (*1* form, *b* color). *Z 1 b* will, of course, have to pass through the same embryological stages as *Z a*, because it was derived from that stock.

As we regard the different variations of form of the species through which a variety passed before reaching its present characteristics, as remaining though usually dormant, by reason of developing or changing into the next, before the final mature form is reached, and having its representative in some embryonic or juvenile period of growth; so, if we conceive the further development as a whole or in part, checked or aborted, at a period when it is rising to the peculiarities of the next or adult form, we can perceive that those special germs whose further development is arrested will simply mature with the prior features without further evolution.

Returning to our illustration again, with *Z 1 b*, we will suppose that by some abnormal condition an arresting of that feature most susceptible to change, color is brought about. Coloration may probably commence development at *R 1*, or some other unknown period, and reach the original preparental characteristic coloration at *V*, and change to the special varietal characteristics at *X*; now, if *W* is aborted, *V* may continue to mature while the tendency is still towards the previous parent stock, and before the peculiarities of their immediate parentage have had an opportunity to dominate.

As various parts commence to develop at different times, a check

upon development at one period might only retard such features as were then commencing to develop; and those which were already too far advanced, and such as had practically no existence, would not be effected. Thus the other unaffected features would continue to develop until maturity towards those of the parents, while the feature which had been aborted would remain stationary, only maturing with the preparental feature, by correlation, at the proper time, and the result would be the form of $Z\ 1 +$ the colors $a = Z\ 1\ a$.—*Eugene N. S. Ringueberg.*

A Transparent Cave Sponge.—How great, says Dr. W. Marshall, in the *Annals and Magazine of Natural History* for December, 1883, is the power of adaptation in the fresh-water sponges, is strikingly proved by the interesting discovery of Dr. Joseph, who found in the grotto of Gurk in Carniolia an absolutely *transparent* (!) form of Spongilla (*Sp. stygia*). As I supposed that this fresh-water sponge, which lives all the year round under the same, or nearly the same, conditions of existence, would form no gemmules, as these would be superfluous, I applied by letter to Dr. Joseph, who forwarded some preparations to me, and at the same time kindly wrote, among other things, as follows: "Your supposition that no formation of gemmules takes place is correct, for neither in September nor in April did I find any." Some people may perhaps think that the Spongillæ of the grotto of Gurk were not descended from ordinary Spongillæ, but directly from Monaclinellidæ of salt water, perhaps at a time when the waves of the Tertiary sea eroded the grottoes of Carniolia and Friuli. This would have much more probability than the supposition that in consequence of uniform conditions of existence, not dependent upon the seasons, retrogression as regards the gemmules has occurred in *Spongilla stygia.*

New Worm with a remarkable Nervous System.—The *Willem Barents*, on her third voyage, captured a worm which A. A. W. Hubrecht describes under the name of *Pseudonematon nervosum.* He gives a general account of its structure, and promises a fuller monograph. The animal is about sixty-five mm. long, one and three-quarters mm. thick, tapering behind. The digestive tract runs straight through, from end to end. On the ventral side, about forty-five mm. from the head, is a disk, probably a sucker. No traces of sexual, excretory, or sensory organs were found. The epidermis is thin. The muscles form three layers, a thick external longitudinal, a middle transverse or circular, and an internal longitudinal layer, variously developed in different parts of the body. The nervous system is very remarkable; it forms a continuous layer completely around the body, and lies immediately inside the layer of circular muscular fibers. It consists (1) of a fine network of delicate filaments, appearing as if felted, barely tinged by the staining reagents; and (2) of scat-

tered nuclei, belonging partly to connective tissue, partly to ganglion cells. The layer forms a continuous tube from the head, where there is no ganglionic enlargement, back through the body to the caudal region, where the layer is present dorsally only.

NEW AND REMARKABLE PENTASTOMUM IN THE AIR-SACS OF A GULL.—P. Mégnin describes a new and remarkable Pentastomum found in the air-sacs of *Larus glaucus*. About six centimeters long and one broad, it has at first sight the appearance of a Trematode; but a microscopic examination reveals the presence of two pairs of symmetrically placed hooks at the anterior end. The new species is remarkable for the attenuated form of the anterior extremity, and the absence of any external annulation. At the front end there are two tubercles which look like aborted antennæ, and below there is an indication of a kind of segment.

On what may be regarded as the second ring there is a pair of small appendages, formed of two joints, which call to mind the characters of larval Pentastomes. The characters of these new species resemble greatly those of the Lernæidæ, and especially of the Chondracanthidæ, and seem to M. Mégnin to raise the question of the systematic affinities of these parasites. If the resemblance to the Lernæidæ is a real one, the Pentastomidæ should be ranged rather with the Crustacea than with the Arachnida.

THE SIDE ORGANS OF GASTROSTOMUS.—Mr. J. A. Ryder communicates to *Science* a description and sketches of the curious pedunculated organs of the lateral line of Gastrostomus. These are placed in groups of from two to five, forming an oblique row on the hinder margin of each muscular somite. The stalks are slender, fully a sixteenth of an inch long, and project outwards quite freely when the fish is immersed in alcohol or water. At the tip of each is a discoidal, more or less cup-shaped organ, which is more or less completely pigmented internally. The peduncles are not pigmented, and the pigment upon the circular areas immediately around the base of each peduncle is slightly reticular and less dense than that of the surrounding skin, which is deeply loaded with black. The pigmented layer of the basal disks is continuous with the outer clear sheaths of the stalks, and the medullary portion of the stalk can be seen in some cases to consist mainly of nerve-fibrils, which pass outwards to the cup-like organs at the tip. Mr. Ryder believes these organs to be tactile, and possibly luminous. In some young fishes there are naked nerve-hills on the sides of the body, and in the young of Gadus the stiff, sensory hairs of these nerve-hills project into the surrounding water; but no larval fish as yet known has pedunculated side-organs, so that in this respect, as in the rest of its organization, Gastrostomus is highly specialized.

ZOOLOGICAL NOTES.—*Protozoans.*—Professor Haeckel, in a recent paper (Sitz. Jenaischen Gesell. für Med. und Wiss., 1883) divides the Radiolaria into four orders: Acantharia, Spumellaria, Nassellaria and Phæodaria. The first are distinguished by their organic acanthine skeleton, and never have a true silicious skeleton. On the whole, they correspond to the Acanthometræ of J. Müller, but include part of the Haliomma. Actinelius, in which the central capsule is pierced by numerous simple, indefinitely arranged spicules meeting in its center, seems to be the ancestral form, and to have arisen immediately from Actinosphærium by the hardening of the firmer axial fibers into spicules. The Spumellaria have no acanthine skeleton, but their central capsule is pierced on all sides by fine pores. The ancestral form is Actissa, the simplest possible Radiolarian. The Nassellaria have a simple area of pores at one end of the capsule axis. The skeletonless *Cystidium inerme* is regarded as an ancestral form, from which others were derived by the development of a silicious skeleton. The Phæodaria surpass all other Radiolarians in size and singularity of form. The skeleton is usually composed of hollow silicious tubes. The common characteristic of the whole order is the *phæodium*, a dark body of pigment, lying excentrically outside the central capsule. The ancestral form is the skeletonless Phæodina.

*Cœlenterates.*—Dr. von Martens reports, from a letter of the African traveler, Dr. R. Böhm, that a jelly-fish has been discovered in Lake Tanganyika. It belongs to the Craspedote medusæ; has a small, short, broad stomach, while the tentacles are very numerous and of unequal length.

*Polyzoans.*—The memoirs of the Novorossian Society contain an elaborate paper by M. Repyakoff, on the relations between the Endoproct and Ectoproct Polyzoa. In the same memoirs, M. Buchinsky publishes a paper on the development of the earthworm, with special attention to its mesoderm and nervous system.

*Mollusks.*—At a recent meeting of the Academy of Sciences of Paris, M. de Lacaze-Duthiers presented a note by M. Houssaye upon the operculum of the Gasteropoda. This investigator has come to the conclusion, contrary to what is generally admitted, that the entire surface of the foot does not take part in the production of the operculum, which is secreted by a small and clearly limited portion of the epithelium. This mode of production seems to be of a different nature from that of the byssus of the Acephala which is formed by a well-developed gland, occupying a considerable part of the volume of the foot. The researches were carried on partly at the laboratory of Banyuls-sur-Mer, and partly at the laboratory of l'Ecole Normale, with animals sent from Roscoff.

*Crustaceans.*—The transformations of a Rhizocephalus and its mode of fixation are, according to M. Ives Delage, who has occupied

three years at Roscoff in observations and experiments upon the subject, more wonderful than has been hitherto believed. The nauplius, after four days and five months, transforms into a cypris, which refuses for three days to fix itself. Then, always during darkness, it attaches itself to young crabs from two to twelve millimeters in width, seizing a hair of the crab with its prehensile antennæ. It may become fixed to any part, but prefers the back of the tail or the base of the legs, never the ventral face of the abdomen. As soon as it is fixed, it is transformed by a molt into a sort of lengthened sac, suspended by its antennæ, and without limbs. This sac secretes at its antennal pole a hollow dart, ending below in a funnel opening into the cavity of the sac, and above in a very sharp point. This dart passes through the cavity of the antennæ that has seized the hair, and pierces the teguments of the crab at the soft ring at the base of the hair. The contents of the sac then commence to enter the funnel end of the hollow dart, and pass gradually into the tissues of the victim. The contents of the sac consist of cellules, of which the superficial ones represent the cellular skin of the larva, while the central ones are a sort of nucleus which existed in the nauplius and cypris, and constitutes the genital organs. When the Sacculina has thus inoculated itself into the body of the crab, it travels to the abdominal region, and the genital nucleus pierces its envelope and the teguments of its host, and appears upon the outside of the crab. Thus the portion of the parasite in the body represents the skin of the larva. The name of Rhizocephalus is therefore inexact, and M. Delage proposes for the group the name *Kentrogonides*, and considers them very different from either Lerneans or Cirrhipeds. The parasite does not fix itself to the zoëa, nor to crabs that have passed a certain age.——Among the Crustacea found by the French expedition to Cape Horn, the most common were the large spiny *Lithodes antarctica;* another, Lithodes *(L. verrucosa)*, with shorter limbs; a Eurypodius, with extraordinarily long limbs; a small Halicarcinus, with a flattened body; a Galatea, and more rarely some shrimps and isopods, among the latter of which the genus Serolis was most common.

*Fishes.*—M. Ralph S. Tarr, in a communication to *Science*, states that in the winter of 1878–79, a million and a half of cod were successfully hatched at Gloucester, Mass., and placed in the clearer waters of the outer harbor. Great numbers of young fish of this species have since been caught, both in the outer and inner harbor, and the results have proved so favorable that an appropriation was obtained from Congress to build the extensive hatching-houses and basins now in course of erection at Wood's Holl, Mass.——At a recent meeting of the Linnean Society of New South Wales, Mr. Ch. de Vis described the following new species of fishes from New Britain and the adjoining islands: *Serranus perguttatus* and *cruentus*, *Mesoprion flavirosea*, *Tetraroge*

*vestita*, *Acanthurus zebra*, *Rhynchichthys novæ-brittaniæ*, *Harpage rosea* (a new Berycoid genus), *Salarias æquipinnis*, *Amphiprion arion*, *Pomacentrus onyx* and *notatus*, *Nesiotes purpurescens* (a new Labroid genus), *Exocœtus longibarba*, *Arius armiger*, *Herpetichthys cobra* (a new Murænoid genus), *Tetrodon insularium* and *lævis*. At the same meeting Mr. W. Macleay gave a list of the fishes captured by a beam trawl outside Port Jackson, in forty to fifty fathoms, and described the two new species, *Raia australis* and *Lepidotrigla mulhalli*.——At a recent meeting of the Linnean Society of New South Wales, Baron M. Mikluko Maclay and Wm. Mackay contribute a paper on the Plagiostomata of the Pacific, and describe *Heterodontus japonicus*. The latter gentleman also describes *Psilecranium coxii*, a large fish of the family Cirrhitidæ, taken at Port Jackson. It is rather near to Chilodactylus.—— Dr. T. Gill, in a communication addressed to *Nature*, January 10, 1884, asks for further information respecting the Saccopharyngidæ, which he believes to be Lyomeri, with the branchio-anal portion much longer than the rostro-branchial, while the reverse obtains in Eurypharynx and Gastrostomus.

*Reptiles*.—M. W. Mackay has described *Tiaris boydii*, a lizard from the Herbert river, Queensland, and three snakes from the same locality: a Tropidonotus, a Dendrophus, and *Herbertophis plumbeus*, a new genus near Coronella.

*Mammals*.—Baron Maclay finds the average temperature of the body of the Echidna to be 78° F., or very little more than that of fish.——M. H. Gervais has described a new species of Megaptera from the bay of Bassorah. Van Beneden, in a recent work, has referred the humpbacks to a single species, but M. Gervais combats this, and recognizes three, *M. boops*, of the northern hemisphere; *M. Lalandii*, inhabiting the South Atlantic; and the species from the Persian gulf, a species which he names *M. indica*. In size this form equals *M. boops*, but the head is more globular and the bones thicker, as well as more compact and denser. The upper profile of the head is more curved, the rostrum more obtuse, and the mandible more arched. The exoccipitals project more and the condyles less than in *M. boops;* the occipital foramen looks more backward; the zygomatic process is shorter and more massive; and the palatines differ from the northern species in their form, their greater thickness, and their extensive articulation with the maxillary. The sternum differs completely in its form from that of any other whalebone whale. There are also many other differences in the shape of the bones of the skull, vertebra, ribs, etc., and the pectorals are proportionately longer than in *M. boops*.

## PSYCHOLOGY.

Peter's Search for Home—Another Cat story.—"Peter" is the name of a small-sized cat now lying at my feet under the kitchen stove, reposing in what might be called a condition of

"solid comfort." He is a most sagacious, affectionate little fellow some seven or eight years old. One of his "specialties" is conversation. Ask him a question, or say, "Good morning, Peter!" and his invariable response is—"Mew!" Ask him a dozen questions in succession, and he seldom fails to answer. I tell him, sometimes, to "whisper," and then he speaks very low, often merely opening his mouth. We think that Peter knows almost everything that cats are ever privileged to know. But here is his little story.

A year ago last August he was taken to town, two miles away, to live with another family. The road lies across a bend in Boone river, the crossing at the upper place being by a bridge, and at the lower one by a ford. Forty rods below the ford, however, there is a long and high railroad bridge. To go around this bend one would have to travel nearly or quite six miles. Well, Peter was kept in close confinement at his new home for a whole week, but upon being released he left, as the Arkansas swamp doctor says, *ed instanti!* Nothing was heard of him for over two months, and we all supposed that dear little "Peter"

> "By the wayside fell and perished,
> Wearied with the march of life!"

Late one November evening, however, his mistress heard and recognized his "voice" out in the garden. But he had been so long without a home, following such devious, hidden ways, that the caution of feral life had well nigh come back to him, and he seemed half afraid to come directly into the house. But a little persuasion finally overcame whatever doubts were flitting through his little brain, and he allowed himself to be caught. Upon getting into the house he was the most pleased, overjoyed animal I ever saw. He talked, and talked, and talked, and "answered questions" until at last his vocal organs utterly gave out, failing to utter any sound whatever, and he could only open his mouth in the vain attempt. In fact, "he was so hoarse that he couldn't speak" for the next two or three days. It was many days before he could give up celebrating his return by his manifestations of delight and pleasure, and settle down to his normal condition of demure, cat life.

On his return he was in good physical condition, but without a particle of fat. His muscles were plump and round, like those of a trained athlete, and it was evident that on his long march for home he had lived upon such meat as he could catch—birds, mice, rabbits, squirrels, &c. But the question was, How did he reach home? By the bridges, or did he come around the bend? He could not know the way home, for he was carried off in a box, and must have been all this time wandering here and there. By sheer good luck he finally achieved the object of his long quest only a few hours before the first winter "blizzard" came howling over the prairies. If his talk were only a little more in-

telligible, I believe that his account of his wanderings, his adventures, his hopes and fears, the big dogs and other dangers from which he must have had narrow escapes, would form one of the most interesting chapters in natural history.

One other fact concerning "Peter" also seems a little out of the way. I often take him on my shoulder for a horseback ride, and he seems to enjoy that sort of diversion very much, and is never afraid, while few other cats could be made to stay a single moment.—*Charles Aldrich, Webster City, Iowa, March 9, 1884.*

THE TEN COMMANDMENTS.—1. If thou art not born an original investigator, thou hadst better teach or compile the works of thy brethren the original investigators.

2. Thou shalt not say, lo! give me money and I will originally investigate; for thy people knoweth that if thou canst not originally investigate without money, thou canst not do it with money

3. If thou desirest to increase thy reputation by depreciating the reputation of thy brethren, know that this is not the object of original investigation.

4. Thou shalt not pretend to discover the general laws of the earth and the things thereof until thou knowest the thing thereof, even the species.

5. Thou shalt therefore not despise him who furnisheth thee with the materials of thy thoughts, even him who describeth species well.

6. Thou shalt not believe that the bigness of the man of science is proportioned to the smallness of the hole through which he seëth the world and the things thereof.

7. Thou shalt not believe that the bigness of the man of science is in proportion to the size and beauty of the pictures which he maketh.

8. Thou shalt not fall into the snare of the Devil, and believe that thou wilt wax great by the making of great names to torment thy people.

9. Thou shalt not write obituaries until thou art well stricken in years.

10. Thou shalt not take the name of the National Academy of Sciences in vain, for thy people knoweth that inwardly thou desirest to be a member thereof.

POETRY IN DREAMS.—In a recent NATURALIST, I saw some "poetry" said to have run through the minds of individuals in dreams, and to have been afterwards recalled. That "reminds me" of an incident in my own experience. I once dreamed of writing several "verses," one of which I have always remembered —or did I get hold of it by some other and forgotten means? I

believe I "dreamed it," and here it is. The four or five other verses I am unable now to recall:

> "The past has been a fleeting shadow,
> Like mist on the mountain side,
> But through the future before me
> Glowing visions swiftly glide!"

Unless I came across this in some book or newspaper, I shall always believe that I composed it in my dream. Next!—*A., 1884.*

## ANTHROPOLOGY.[1]

THE NORTHERN FRONTIER OF CHINA.—When the Mongols first becam epowerful under Chinghis Khan, Eastern and Central Asia was divided into four considerable empires: 1. The Kin or Golden Tartars occupied the six northern provinces of China, they were the ancestors of the Manchus; 2. Central Asia was subject to the empire of the Kara Khitai; 3. The Sung dynasty, controlling Southern China, was a purely Chinese empire; 4. The fourth empire was that known to the Chinese as Hia or Tangut, and forms the subject of Part VI in a series of papers on the northern frontages of China, by H. H. Howorth, published in the Journal of the Royal Asiatic Society.

THE PEOPLING OF THE EARTH.—M. Zabarowski, a distinguished member of the Paris faculty of anthropology, reviews the various theories of the distribution of our race over the earth. The peopling of the earth is at present regarded from two points of view. The first is the belief that man has not appeared simultaneously in all the grand divisions. On the contrary, in the savage state, deprived of the facilities at our disposal, men have effected migrations on a grand scale. Upon this point M. de Quatrefages has successfully opposed the theories of Agassiz, that there were as many centers of human origin as there are races of men.

THE TRIBES OF EGYPTIAN SUDAN.—Professor A. H. Keane contributes to *Nature* of Jan. 24, a paper on the Egyptian Sudan and its inhabitants, an abstract of which is given below. Sudan is the Arabic equivalent of Nigritia, Negroland. Its sections are: (1) *Western Sudan*, the basins of the Senegal and Quovra-Bénue (Niger); (2) *Central Sudan*, the basins of the Komadugu and Shau, with lands draining into Lake Chad; (3) Eastern Sudan, east of Waidai, the Upper and Middle Nile basin, now known as *Egyptian Sudan*. The provinces formed out of this territory in 1882 were:

WEST SUDAN—Darfur, Kordofan, Bahrel-Ghazal and Dongola, with capital, Fasher.

CENTRAL SUDAN—Khartum, Senaar, Berber, Fashoda and the Equator (Hat-el-Istwa), capital Khartum.

EAST SUDAN—Taka, Suakin and Massowah, with capital, Massowah.

HARRAR—Zeyla, Berbera and Harrar, with capital, Harrar.

[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

The following is Mr. Keane's ethnologic chart.

| RACE | MAIN DIVISIONS. | LOCALITY. | REMARKS. |
|---|---|---|---|
| HAMITES. | *Tibbu:* Baele, Zoghawa, Wanyanga. | N. & N. W. Darfur. | *Hamite, Kushite* of some writers, answering to the African division of the Mediterranean or Caucasic anthropologic type. For the removal of Tibbu from the Negro to the Hamite race, see *Nature*, March 1, 1883 (North African Ethnology). Most of these are zealous Muhammadans. |
| | *Bishari* (Beja): Hadendoa, Hallenga, Ababdeh, Beni-Amer. | Between Red sea and Nile, 15°–25° N. | |
| | *Danakil:* Adaiel, Dahimela, etc. | Between Abyssinian coast, 10°–15° N. | |
| | *Saho; Bogos; Habab; Somali:* Idur; Isa; Mijarten, etc. | Massowah district. Gulf of Aden coast. | |
| | *Galla* (Orma): Yeju, Wolls, Mecha, etc. | E. and S. of Gojam. | |
| SEMITE. | *Arab:* | | The Arab Semites are recent intruders, mainly *via* Isthmus of Suez and Egypt. The Himyarites are intruders from prehistoric times, from S. Arabia *via* Strait of Bab-el-Mandeb. The former Muhammadans; the latter monophysite Christians. |
| | Kabahish; Sheygieh; Robabat, etc. | W. f. Nile, bet. Dongola & Khartum. | |
| | Homran; Rekhabin; Alawin. | Senaar. | |
| | Homran; Hanor; El-Hanor; Habanich, etc. | Kordofan and Darfur. | |
| | Ziaieh; Bahemid. | N. Darfur. | |
| | *Himyaritic:* | | |
| | Tigré; Dembela; Lasta; | N. and E. Abyssinia. | |
| | Harrari. | E. from Shoa. | |
| NUBA. | *Barabra* (mixed)- Kenus, Mahasi; Dongolawi. | Nile valley, Egypt to Old Dongola. | *Nubas* intermediate between the Negro and the Hamite. Speech, Negro. No connection with the Fulah of W. Sudan. The Kordofan Nubas original stock, Pagans. Those of the Nile, Negroid Christians from V–XIV cent. Since then mild Muhammadan. They are the Uaua of Egyptian records; *Nubæ* of Strabo, later Nubatæ. |
| | *True Nuba:* Kargo; Kultan; Kolaji; Jebel Nuba, Tumali. | Kordofan. | |
| | *Fur:* Fur; Konjara; Fongoro, etc. | Darfur. | |
| | *Sub-Nuba:* Takruri, | Gallibat. | |
| | Barea; Basé (Kunama); | Taka, Mareb valley. | |
| | Funj; Hamagh. | Senaar. | |
| NEGRO. | *Sudanese:* Beikit; Masalit, Abu-sarib, etc. | Darfur. | Most of these Negroes still Pagans. Some, as Mittu, Krej and Bongo, red-brown rather than black, but the type is Negro. Speech of all except the Dinka, shows grammatic gender. |
| | *Nilotic:* Shilluk, Dinka. Nuer. | White Nile and B. el Arab. | |
| | Fallaugh; Kumbung; Ninak, etc. | Sobat basin. | |
| | Krej; Bongo (Dor); Mittu (Moro). | About W. tributaries of White Nile. | |
| | Bari; Madi; Lur; Latuka. | B. el Jebel, N. of L. Albert Nyanza. | |
| BANTU. | Waganda; Wanyoro. Wasoga; Wagamba. | Extreme S. frontier, N. side of L. Victoria Nyanza. | Bantus not reduced. Included in the Moudirié de l'Equateur of Messedagliás official, "Carte du Sudan" (Khartum, 1883). |

THE COLOR OF THE EYES AND HAIR.—M. C. Ikow contributes to the Bulletin of the Paris Society of Anthropology, Vol. XVI, pp.

440–457, a paper on the classification of the color of the eyes and of the hair. Our knowledge of the nature of pigment in man and the other mammals is unfortunately still imperfect; we do not know whether the coloring matter is unique or whether there are many elements by whose combination the great variety of color is produced. M. Ikow, therefore, claims only to have made use of facts so far as they have been established. The following is his scheme:

PRIMARY GROUP.

| | | |
|---|---|---|
| 1. *First fundamental natural group.*— The iris contains no pigment. | The iris is blue or gray of diverse shades, according to the nature of the iris. | Apparent color of the iris, blue or gray, of different intensity (tone). |
| 2. Second fundamental natural group.— The iris contains pigment which occupies the entire field. | The iris is in reality brown, varying from yellow-brown to black-brown. | The apparent does not differ from the real color, although it seems of a little deeper intensity. |

SECONDARY GROUP.

| | | |
|---|---|---|
| 3. Intermediate group between the two fundamentals.—The pigment is deposited in the iris but does not occupy more than a third or two of its field. A peripheral zone is completely deprived of pigment. | The iris is composed of two parts: 1. A central zone around the pupil, brown or yellow in color according to the quantity of pigment; and 2. A peripheral zone of blue or gray color. | Color of the iris apparently sometimes green, sometimes yellow, sometimes bronze, rarely gray-yellow. |

FUNDAMENTAL GROUPS.

*Color of the Hair.*

| | |
|---|---|
| 1. Blond hair (color of flax). | Pigment in small quantities. |
| 2. Black hair (pure black and shining). | Pigment in considerable quantity. |
| 3. Intermediate, chestnut brown. | Pigment in moderate quantity. |

*a*. Clear chestnut. *b*. shaded chestnut.

STONE IMPLEMENTS FROM MINNESOTA.—In 1881 Miss Frances E. Babbitt, of Little Falls, Minnesota, made the important discovery of stone implements and chips of quartz at the depth of fifteen feet in the gravel forming the modified drift on the banks of the Mississippi river at Little Falls, Morrow Co., Minn. Since then she has made repeated examinations of the gravel, and has taken out many specimens of chipped and worked quartz from the same stratum, all of which were found in a very limited area. A series of the specimens was exhibited at the Minneapolis meeting of the A. A. A. S., in connection with her paper, giving a full account of her work, and containing a statement on the geological conditions by Mr. Warren Upham, as assistant to the State geologist. In this account Mr. Upham gives his testimony to the discovery of the implements by Miss Babbitt, in the modified drift, and we therefore owe to her the knowledge of the existence of man at that early period in the Mississippi valley; another of the facts which are slowly but surely pointing to the great antiquity of man on our continent. After the meeting Miss Babbitt

most kindly presented the whole collection on exhibition to the Museum of Archæology at Cambridge, Mass., and since its arrival I have again examined the specimens, and have no hesitation in pronouncing a large proportion of them as the work of man. Some are simple chips or flakes, split off in the process of working the stones into shape. Others are pointed pieces of quartz which may in part be natural fractures, but which have received a few finishing blows from the hands of palæolithic men. A few others, including one or two not of quartz, are evidently natural forms, but in the collection are about a dozen unquestionably chipped implements, which, except that they are made of quartz instead of argillite, closely resemble the palæolithic implements found by Dr. Abbott in the New Jersey gravels. For the present I refer to Miss Babbitt's paper, now in course of publication by the American Association for the Advancement of Science for further details, but I hope at no very distant day to give illustrations of these specimens in our reports, as the museum has now become their owner.—*F. W. Putnam.*

## MICROSCOPY AND HISTOLOGY.[1]

METHODS OF STUDYING THE SO-CALLED LIVER OF THE CRUSTACEA.[2]—For the study of fresh tissues Dr. Frenzel places a small piece of the organ on the slide, *in the blood of the individual from which it was taken;* or, *in sea-water diluted until the salt contained amounts to about* 1½–2 per cent (one part distilled water and one part sea-water from the Bay of Naples). The so-called "physiological salt solution" (¾ per cent) worked unfavorably, causing maceration.

Various fluids were employed for killing and hardening, partly for determining the effect of different reagents on the nuclei and the protoplasm, and partly for finding the best means of preparing the object for sectioning.

Very good preparations were obtained with *warm* alcohol from seventy per cent to ninety per cent; while direct immersion in absolute alcohol did not prove advantageous. This treatment gave good results for the cell protoplasm, but destroyed the structure of the nuclei. Still better results were obtained for the cells (not for the nuclei) by adding a few drops of iodine to seventy per cent alcohol.

The most satisfactory results were reached by immersing the object in a saturated aqueous solution of corrosive sublimate from ten to thirty minutes, then washing with water, and finally replacing the water gradually with alcohol.

Perenyi's fluid gave best results when combined with corrosive sublimate. The object was left from five to ten minutes in the

[1] Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoology, Cambridge, Mass.

[2] Johannes Frenzel. "Ueber die Mitteldarmdrüse der Crustaceen," Mittheil. a. d. Zool. Station, v, p. 51, 1884.

first-named fluid, then transferred to the second and left for the same time.

While these methods were good for the Decapods, Amphipods and Phronomidæ, the Isopods required a different treatment. With these Kleinenberg's picro-sulphuric acid, diluted with an equal volume of water, and allowed to act 15–20 minutes, gave much better preparations than the sublimate solution.

A NEW SECTION FLATTENER.—The following device as an anti-roller has been recommended by Gage and Smith:[1]

"The section flattener consists of a rod (*b*) of spring brass, about $5^{mm}$ in diameter, flattened on two sides (*B* and *D*), extending parallel with the edge of the knife, and projecting about $2^{mm}$ beyond it. Opposite the cutting edge the space between the rod and knife is about $1^{mm}$, while nearer the back of the knife the distance is greater (Fig. 1 *D*, *a*, *b*). At each end the rod is bent at right angles. Next the handle it passes through a hollow cylinder (Fig. 1, *d*), into which it is secured by a milled nut (Fig. 1, *c*). At the free end of the knife, the rod is hooked over the back of the blade (Fig. 1, *A*), the spring of the wire securing it firmly. At the two angles of the rod it rests on the blade, so that in cutting sections any amount of pressure may be applied at these points. The rod is attached to the knife by means of a clamp, which consists of two pieces clasping the tang and held together by a screw (Fig. 1, *C*). To clean the knife and rod, or to remove sections, the rod may be raised as it swings freely in the hollow cylinder attached to (*d*). The rod may be removed by removing the milled nut (*c*); the entire apparatus may be removed from the knife by loosening the screw *(f)*."

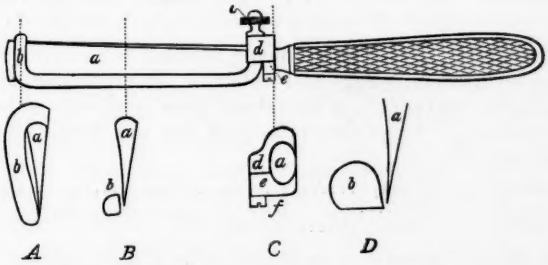


FIG. 1.—The section flattener attached to a knife. (*a*), blade of knife; ($a^1$), tang; (*b*), section flattener; (*c*), milled nut; (*d*), the part of the clamp bearing the hollow cylinder; (*e*), part of clamp; (*f*), screw holding the two parts of the clamp together.

*A*, section showing the end of the flattener hooked over the blade; *B* and *D*, sections showing the form of the rod (*b*), and its position with relation to the edge of the knife; *C*, section of the tang, showing the manner of attaching the clamp.

The section-smoother introduced by Andres, Giesbrecht, and

[1] "Section Flattener for Dry Section Cutting." *The Microscope, February, 1884.*

Mayer, described in the December number of this journal, is one of the simplest devices that has thus far been offered, and is perfectly adapted to both large and small sections. It is provided with an adjusting apparatus, the absence of which is a defect in the above instrument of Gage and Smith, and is applicable to knives of different forms and sizes.

*Methods of Preparing the Alcyonaria.*—Dr. Wilson[1] has employed with success the following methods in preparing the Alcyonaria for histological purposes:

"After testing many preservative and staining fluids, the following methods were adopted as giving, upon the whole, the best results: The animals were suddenly killed by momentary immersion in a mixture of one part strong acetic acid and two parts of a concentrated solution of corrosive sublimate in fresh water. After being quickly washed, they were transferred to a concentrated solution of sublimate in fresh water, and left two or three hours, the internal cavities being injected with the solution where this was possible. They were then thoroughly washed in running sea water, then in distilled water, and finally preserved in successive grades of alcohol.

"A weak solution of iodine in alcohol and sea water also gives beautiful results, but is less certain in its action. For staining I have used Grenacher's alum-carmine, borax-carmine, picro-carmine and Kleinenberg's hæmatoxyline. Much the best results are obtained by the use of alum-carmine, but it must be used as quickly as possible, since the gelatinous tissue of the mesoderm is apt to shrink if the object be left too long in aqueous fluids. The tissues were decalcified with very weak nitric or hydrochloric acid in ninety per cent alcohol. For maceration, the Hertwig's well-known mixture of osmic and acetic acids gives good results."

PERENYI'S FLUID.[2]—The following mixture is recommended by Perenyi for hardening eggs and embryos. It kills instantaneously, and preserves the object in its natural form and size without the least shrinkage. Eggs thus preserved are not brittle, but "cut like cartilage:"

| | |
|---|---|
| Nitric acid (10 per cent) | 4 parts. |
| 90 per cent alcohol | 3 " |
| Chromic acid (½ per cent) | 3 " |

This mixture assumes a violet hue after a short time.

Eggs may be left in this fluid 4–5 hours; then twenty-four hours in seventy per cent alcohol; then in ninety per cent. alcohol one or two days; finally 4–5 days in absolute alcohol.

The staining fluid may be best added to the fluid itself, so that the eggs are hardened and colored at the same time. Fuchsine

[1] Dr. E. B. Wilson, "The mesenterial Filaments of the Alcyonaria." Mittheil. ungen aus der Zoölog. Station zu Neapel. v., p. 3, 1884.

[2] Josef Perenyi. "Ueber eine neue Erhärtungsflüssigkeit," Zool. Anzeiger, v, No 119, p. 459, 1882.

and analine red dissolve directly in the fluid, while eosine and purpurine are first dissolved in three parts alcohol.

Picro-carmine or borax-carmine mixed with the fluid, give excellent staining. The addition of staining fluids causes a precipitate, so that before using the fluid should be filtered.

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## SCIENTIFIC NEWS.

— In the death of Professor Arnold Guyot, who was born near Neufchatel, in 1807, we have lost our most eminent geographer, and a geologist whose reputation was worldwide. He began his life's work as a student of Ritter, the influence of whose instruction is seen in the "Earth and Man." While a professor in the University of Neufchatel, where he filled the chair of universal history and physical geography, from 1839 to 1848, he studied, with Agassiz, the structure and physics of the existing glaciers, but especially distinguished himself by determining the limits of the ancient glaciers of Switzerland, Savoy and Lombardy, and demonstrated the identity of the laws of the distribution of erratic boulders and gravels with those of glacial moraines. In 1848 he came to this country, and was for thirty years perhaps the most distinguished member of the faculty of Princeton College. While here he organized for the Smithsonian Institution a system of meteorological observations, and thus paved the way for the establishment of the present signal bureau. His most important geographical essay was his "Physical structure of the Appalachian mountains" (1861). He wrote a series of text-books on physical geography, and stimulated greatly the popular interest and appreciation of this subject. As a lecturer and writer, he was clear, comprehensive and finished; as a man, singularly pure, simple-hearted, unselfish and sincere. It was a benediction to come in contact with him.

— Dr. George Engelmann, who died February 4, was born at Frankfort-on-the-Main, February 2, 1809. Removing to the United States in 1832, he soon after settled as a physician at St. Louis. His botanical studies, which made him famous, were carried on in the limited leisure of a busy practice. For nearly thirty years he studied the Cactaceæ, his elaborate monographs appearing in the reports of the Pacific Railroad and the Texas Boundary survey. He monographed the pines, and the North American group of Cuscuta, Juncus, Euphorbia, Quercus, Vitis and Agave. He ranked as a botanist only second to Dr. Gray. He was one of the founders and most active members of the St. Louis Academy of Science. He also was the oldest American meteorologist, his observations extending over a period of forty years.

— The *Zoölogischer Jahresbericht for 1882*, so far as relates to the invertebrates, has made its appearance. It is of the same size, with the same editors, as in former years, and is equally in-

valuable to the American zoölogist on account of its detailed summaries of papers and works devoted to zoölogy in all its relations. The different divisions are for sale separately. No biological laboratory, college, or museum library is complete without this work, as well as the briefer English *Zoölogical Record.* It is earnestly to be hoped that, though the German *Jahresbericht* is published at great expense of time and money, it will not be suspended for want of adequate support. American zoölogists will find the work peculiarly valuable.

— At the meeting of the Geological Society of London, held February 15, the society's Lyell medal was awarded to Dr. Joseph Leidy, of Philadelphia, with the sum of 25*l.*, in recognition of his valuable services to palæontology, especially his investigations on the fossil Mammalia of Nebraska and the Sauria of the United States. The council also awarded to Professor Leo Lesquereux, F. C. G. S., the sum of 20*l.* from the proceeds of the Barlow-Jameson fund, in recognition of the value of his researches into the palæobotany of North America, and to aid him in further investigations of a similar kind.

— Drs. D. G. Brinton and Benjamin Sharp have been elected to the chairs of Archæology and Ethnology and Invertebrate Zoölogy respectively, in the Philadelphia Academy of Natural Sciences.

— The University of Pennsylvania is about to establish a school of biological research, and has raised a fund for its endowment.

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## PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Biological Society of Washington, March 8.—Communications: Dr. J. H. Kidder, U. S. N., Exhibition of specimens of bacillus tuberculosis; Dr. D. E. Salmon, Exhibition of specimens of infectious tuberculosis in cattle; Col. Marshall McDonald, The influence of temperature upon the movements of fish in rivers; Mr. Charles W. Smiley, What fish-culture has first to accomplish; Dr. R. W. Shufeldt, U. S. A., Remarks on the patella; Mr. Romyn Hitchcock, Exhibition of specimens of Orbitolites, with notice of Dr. Wm. B. Carpenter's investigations.

Papers read by title: Mr. Robert Ridgway, Descriptions of some new North American birds. Description of a new American Kingfisher. Note on *Psaltriparus grindæ* Belting. Note on the generic name Calodromas. Mr. Leonard Stejneger, Diagnosis of new species of birds from Kamtschatka and the Commander islands. Dr. T. H. Bean and Mr. H. G. Drexel, Diagnosis of three new species of fishes from the Gulf of Mexico. Mr. G. Brown Goode and Dr. T. H. Bean, A new genus of Pediculate fishes.

March 22.—Communications: Col. Marshall MacDonald, Exhibition of charts showing natural and restricted river distribution

of the shad (by special request); Dr. R. W. Shufeldt, U. S. A., Remarks on the patella; Mr. Romyn Hitchcock, Exhibition of specimens of Orbitolites, with notice of Dr. Wm. B. Carpenter's investigations; Professor C. V. Riley, Personal reminiscences of the late Dr. George Englemann; Mr. William H. Dall, Exhibition of corals from Alaska, with descriptions of new species; Mr. Richard Rathbun, Exhibition of a peculiar growth of coral from Key West, Florida; Dr. M. G. Ellzey, The prepotency of the male parent; Dr. Leonard Stejneger, Exhibition of specimens of the great Kamtschatkan sea eagle, *Haliætus pelagicus.*

New York Academy of Sciences, March 10.—The following paper was presented: Recent visits to the "Singing Beaches" of Scotland and America, by Professor H. Carrington Bolton.

March 17.—The following papers were read: Notes on a visit to some of the snow-peaks of Oregon, by Professor John S. Newberry; Observations on the geology of the vicinity of Golden, Colorado, by Dr. N. L. Britton.

March 24.—The following paper was read: The topography of Egypt between lat. 28° and 30°, from original surveys made in 1882 and 1883, with especial reference to the erosions (—200 feet of the Reian and Qerûn basins, and the natural eminences (+950) feet) and the pyramids (+ 650) in, at or near the storage-reservoir of Pithom-Moeris (with lantern illustrations), by F. Cope Whitehouse, M.A., etc.

Boston Society of Natural History, March 5.—Professor A. Hyatt discussed the origin of the tissues, spermatozoa and eggs among sponges (Metazoa), and the habit of cellular conjugation, from the Protozoa. Dr. M. E. Wadsworth read a paper on the structure of the earth's interior.

March 19.—Mr. S. Garman spoke on the use of polynomials as scientific names; Dr. C. O. Whitman discussed the origin of the vertebrates; and Professor G. L. Goodale read a paper on certain vegetable monstrosities.

Appalachian Mountain Club, Feb. 13.—Professor W. G. Farlow read an account of some of the diseases and deformities of trees in the White mountains; Mr. C. E. Ridler described a trip to Prince Edward island and Blomidon; and the following papers were read: Mountain adventures by Sig. Alessandro di Placido, including a winter ascent of Fujiyama, Japan, as communicated by him to Samuel Kneeland, M.D.; A winter ascent of Mt. Adams, by Mr. W. H. Pickering.

Feb. 20.—Rev. John Worcester described some of the mountain views of Sinai and Palestine, illustrating his remarks with sixty or more lantern views.

March 12.—Mountain adventures by Sig. Alessandro di Placido, including a winter ascent of Fujiyama, Japan, as communicated by him to Samuel Kneeland, M.D.; a paper by C. H. Ames, entitled, The mountains near Ktaadn iron works, Me., was

to be presented; there was also read a paper by Samuel Kneeland, M.D., entitled, A visit to the crater of Vesuvius at night in April, 1882.

PHILADELPHIA ACADEMY OF NATURAL SCIENCES, Dec. 20.—Dr. A. J. Parker called attention to a previously unnoticed mode of reproduction in *Amphileptas fasciola.* One end broke up into amœboid particles, while the remainder, with its cilia, was active. The creature afterwards resumed its original form. The Rev. Dr. McCook spoke of the occurrence of *Formica rufa* in Dakota. In the center of the mounds was a mass of small twigs, forming a ball some eight inches in diameter, and galleries run downward from this for four or more feet. As the material of the nests is largely composed of vegetable fragments, prairie fires burn them out, forming large cavities.

January 10, 1884.—A paper by Miss Foulke, describing the reproduction of *Clathrulina elegans*, was read. Professor Lewis exhibited a mass of cast-iron which contained crystals of graphite, which again held particles of cast iron. The mass contained also pieces of unaltered anthracite. The presence of such pieces of coal, unconsumed through lack of oxygen, was considered to illustrate the way in which carbon may exist in meteorites or chalcopyrite in trap. Dr. Sharp stated that he had determined the presence of so-called retinal cells in the mantle of many lamellibranchiata, including Mya and Ostrea. The structure was the same as that of the primitive eyes of *Solen ensis* previously described. The relation between these eyes and those of Medusæ could scarcely be traced. At the previous meeting, Dr. Leidy called attention to specimens of tin ore from the Black Hills, and stated that he had been informed that a large quantity of such ore existed.

Jan. 16.—Dr. Leidy, in the course of remarks upon the life-forms thrown up at Atlantic City by recent storms, noted the presence of the holothurian *Caudina arenata.* This was probably the first recorded occurrence of this species on the New Jersey coast. Examples six inches long were found. Professor Heilprin, speaking of the Tertiary formations of the Atlantic coast, stated that the Vicksburg beds were, as determined by Conrad, probably of the same age as the Mayence basin, as *Orbitolites mantellii* was characteristic of both and of Oligocene beds generally. The strata immediately beneath the Vicksburg rest on strata which are the equivalent of the *Calcaire grossier* of France, and contains Zeuglodon remains. In the Grand Gulf beds of the far south of Alabama, Mississippi and Louisiana, no determinable invertebrate fossils had been seen. The Jackson beds probably extend farther up in Mississippi than had been supposed by Hilgard. Remarks upon the abundance of chaplets of eggs of Fulgur during the winter led Dr. Leidy to state his belief that they are laid in winter and cast up by the spring storms.